# SCIENTIFIC AMERICAN

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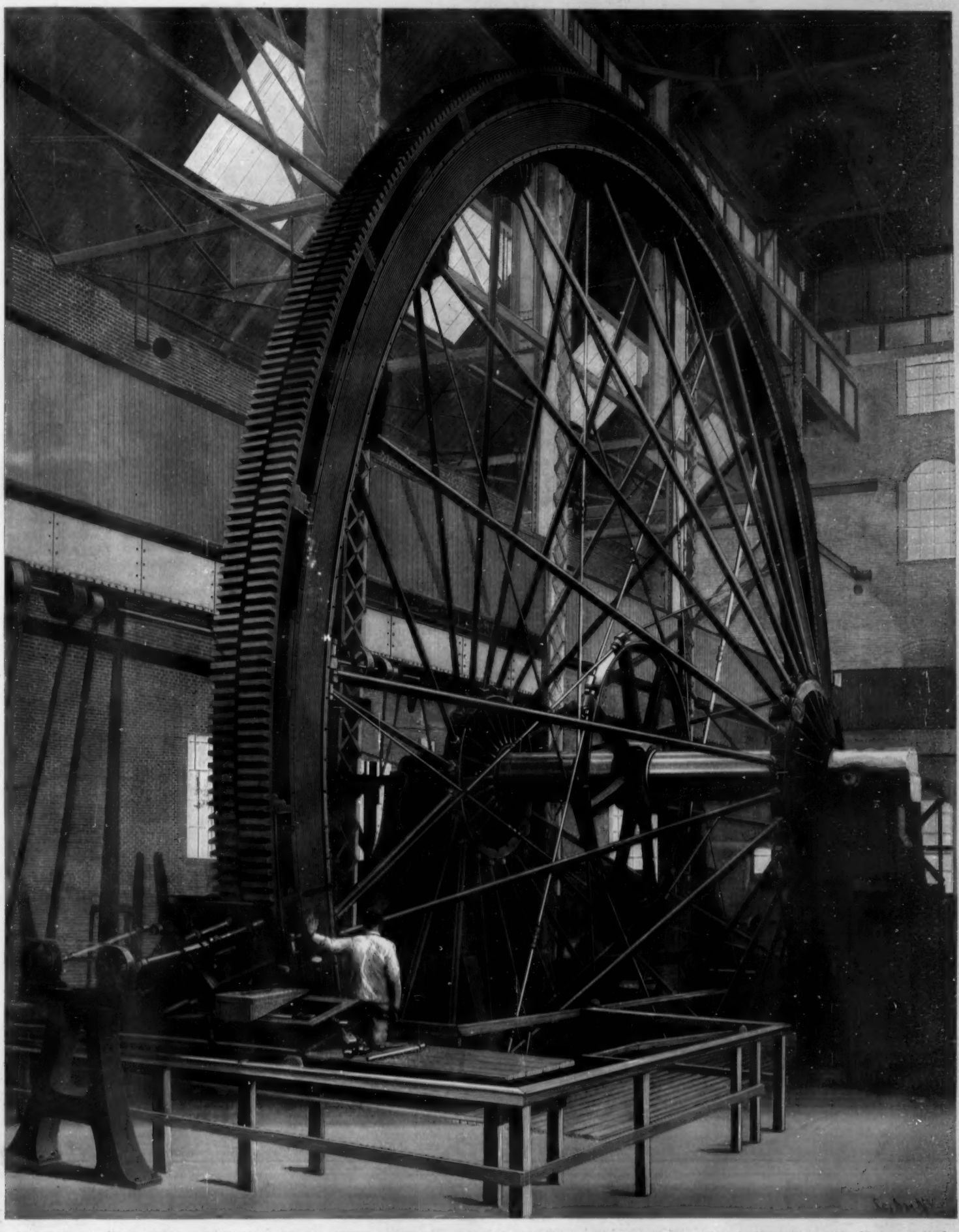

GIANT SAND WHEEL FOR THE CALUMET AND HECLA MINING COMPANY.—DIAMETER, 65 FEET; WEIGHT, 50 TONS; NUMBER OF BUCKETS, 550.—[See page 411.]

# SCIENTIFIC AMERICAN
ESTABLISHED 1845

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NEW YORK, SATURDAY, DECEMBER 21, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


## PENNSYLVANIA RAILROAD TERMINAL STATION AND TUNNEL.

The many recent rumors regarding the construction of trunk line railroad tunnels beneath the Hudson and East Rivers have culminated in an authorized publication of the plans of the Pennsylvania Railroad and the Long Island Railroad for a great central station in Manhattan Island and a series of through tunnels between New Jersey and Long Island. The tunnels will commence in Jersey beyond the Hackensack Meadows, and will run, side by side, in two 18-foot tubes beneath the Hudson River. Near the Manhattan shore the two tubes will diverge, one being carried under West 31st Street and the other below West 32d Street. At Tenth Avenue the tubes will open into a vast central station, which will extend from Tenth Avenue to Seventh Avenue. From Tenth Avenue to a point between Ninth and Eighth Avenues the station will be one block in width, and from there to Seventh Avenue it will be two blocks in width, reaching from 31st to 33d Streets. From Seventh Avenue eastwardly the road will consist of three tracks laid in three separate tubes, there being a single tube beneath 31st, 32d and 33d Streets. When the East River is reached, the three tunnels will swing northward and converge toward Long Island, where they will reach the surface, in the neighborhood of Thompson Avenue.

The great central station, which will have an extreme length of 1,500 feet and an extreme width of 520 feet, will be a truly gigantic affair, the platforms alone aggregating two miles in length. It will be a through station, as distinguished from the terminal stations of the New York Central at 42d Street, or of the Pennsylvania Road on the New Jersey side of the river. It will probably form the busiest center of traffic in the world, for in spite of the fact that it is largely a through station, the plans show provision for twenty-five tracks on the large amount of space, four and a half city blocks in all, which will be included in the station. Extending over the tracks there will be a bridge 100 feet wide, which will reach from 31st to 33d Streets. The approach to the bridge will be by an evenly-graded carriageway at each end. From the bridge stairways will lead down to the platform, and in the whole disposition and operation of the station the very latest appliances for handling baggage, ticket offices, etc., will be employed.

The tubes will have an internal diameter of 18 feet, and in the work of carrying them beneath the East River it is not expected that any novel or complicated features will be encountered. Beneath the Hudson River, however, the work of driving the tunnels is rendered difficult by the great depth of the silt and mud on the river bottom, which extends to 100 feet or more before a firm material is reached. This part of the tunnel is to be built on a new principle which has been designed and patented by Mr. Jacobs, the Consulting Engineer of the Long Island Railroad. It consists practically of a single-track bridge, inclosed in an 18-foot steel tube, with supporting piers extending down from the truss-work to a secure footing on the underlying hardpan. This method of construction is an entirely novel one, and if it should be finally adopted, the building of this part of the tunnel will be watched with the keenest interest throughout the engineering world.

The importance of the great work outlined above can scarcely be overestimated. With the exception of the New York Central Station, there is no trunk line station on Manhattan Island, all the western roads terminating on the western shore of the Hudson River. The scheme is the outcome of the recent acquisition by the Pennsylvania Railroad of the Long Island system, and its completion will at once link the Long Island railways with the great Pennsylvania system. It will be possible to take a car from Long Island direct to Chicago or San Francisco, and it may bring into prominence once more the dream of the late Austin Corbin of a great terminal shipping point at Montauk Point for a line of transatlantic passenger vessels. The construction of this tunnel, moreover, will postpone indefinitely, probably forever, the construction of the much-talked-of bridge or bridges across the Hudson River. There has never been any question of the relative economy of tunnels over bridges of the magnitude of the North River structure, and if the tunnels, as will probably prove to be the case, are expeditiously operated, free from objections in the way of poor ventilation and from other discomforts, we may look to see them adopted exclusively for railway travel between Manhattan Island and the New Jersey shore.

## NICARAGUA OR PANAMA.

The time is rapidly approaching when the nation, through its representatives, will be called upon to decide where the great Isthmian Canal shall be built. The President's commission has done its work, which consisted not merely in a thorough survey of the Nicaragua route, but an examination on the spot of the Panama scheme. Although the work of the Commission included a survey of all other supposedly practicable routes for a canal, it has always been well understood that the actual question to be decided was that of the relative advantages of the routes at Nicaragua and Panama.

A valuable contribution to the literature on this subject is a pamphlet which embodies the gist of an address to the Chamber of Commerce of the City of New York, recently delivered by the former Engineer-in-Chief of the Panama Canal, Mr. Philippe Bunau-Varilla. The address, which will be found in full in the current issue of the SUPPLEMENT, consists of a comparison of Nicaragua with Panama, based chiefly upon the preliminary report of the Isthmian Canal Commission of 1900, and the report of the Nicaragua Canal Commission, 1897 to 1899. The figures in his address which are not taken from those two American reports have been drawn from the report of the Technical Commission of the new Panama Canal Company, which contains the names of some of our most distinguished American hydraulic engineers. Although this address is, as was to be expected, a strong argument in favor of the superior claims of the Panama Canal, the facts and figures given are based upon authentic data, and the high technical authority of the ex-Chief Engineer of the Panama Canal renders it a very timely addition to the literature upon this most important subject.

RESPECTIVE LENGTHS OF CANAL NAVIGATION.—According to the figures given by the Isthmian Canal Commission, the total length of the canal navigation at Nicaragua will be 120.53 miles, to which are to be added 66 miles in free deep water, either in river or lake, making a total length of 186.53 miles from ocean to ocean. Of the 120.53 miles of canal, 22.19 miles will consist of an artificial channel dug below the bottom of Nicaragua Lake, and 27.96 miles will consist of a similar channel dug through sand and silt below the bed of the upper San Juan River, the larger part of which excavation will be more than 16 feet below the natural bed of that river. At Panama there are only 38 miles of canal navigation proper and 7 miles of deep-water navigation through the artificial lake which will be formed by the Bohio dam.

DEPTH OF GREAT CUTS.—The great Culebra cut is not to-day what it was when the old Panama Company was undertaking the work of construction. Originally 274 feet in depth, it has been reduced by the constant work which has been going on under the new company until to-day only 110 feet of excavation remains to be done. On the Nicaragua route there is one cut of 297 feet in depth, and there are others of 218 and 170 feet in the low valley of the San Juan River. On the question of the relative difficulty of constructing the great dams which are the essential features of each project, Mr. Bunau-Varilla quotes the Isthmian Canal Commission as stating that the Bohio dam can be built of earth as well as of masonry, whereas the great dam across the San Juan River at Boca San Carlos would be the most difficult engineering work in connection with the project, since it would necessitate compressed air foundations to a depth of 100 feet below low-water level of the river, and would have a total height of 150 feet from crest to foundation.

CURRENTS.—After drawing attention to the fact that nine locks are necessary at Nicaragua and only five at Panama, and that the level to which ships will have to be lifted will be at Nicaragua 110 feet and at Panama 90 feet, all of the locks of Panama being founded on rock and five only of the Nicaragua locks having the same advantage, the author of the paper passes on to the most important question of river currents, concerning which he says: "The San Juan River, having a much larger watershed than the Chagres River, and from two to two and one-half times more rain falling at Nicaragua than at Panama, the quantity of water that must pass off is much greater at Nicaragua, and must generate more permanent and intense currents than will be the case at Panama, where the great floods of the river are of very short duration and do not occur at more frequent intervals than three years." Ten years' measurements show that the average discharge of the Chagres River, where the Chagres and the canal have the same location, has been about 3,400 cubic feet a second; while measurements taken in 1898 in the San Juan River show the average mean discharge above the mouth of the San Carlos to be 25,000 cubic feet a second. Moreover, the total rainfall in 1898 was but slightly over 201 inches, whereas in 1890 it was 296 inches, 214 for 1891, and 291 for 1892, so that the discharge of the San Juan River would seem to average, in a series of years, from 35,000 to 40,000 cubic feet per second for the whole year, or from ten to twelve times more than that of the River Chagres. In this connection it is asked, "What will be the effect of this great fall of water on the canal channel where this channel lies in the bed of the San Juan River?"

THE QUESTION OF SILT.—It will be remembered that the original Menocal scheme contemplated the erection of a dam below the mouth of the San Carlos River. This was open to the objection that the San Carlos River, which is subjected to enormous freshets, brings down huge quantities of volcanic silt from the Costa Rican volcanic range in which it heads. The present plans have moved the dam further up the San Juan, so as to avoid these floods and the silt they bring down. Nevertheless, the canal above the dam will receive the waters of the tributary rivers Frio and Poco Sol, which, like the San Carlos, have their watershed upon the slopes of the volcanic range. The Poco Sol is estimated to have a drainage area about one-third of the San Carlos, and the question is asked: What disposal will be made of the enormous deposits of sediment brought down by this river and emptied into the canal? Leaving aside the question of amount of sediment carried down by the River San Juan, or thrown into it by its tributaries, the author of the paper furthermore remarks that the maintenance of a channel of the required width and depth is, by itself, a very difficult problem in such a powerful stream as the San Juan, since "nature does not like a regular depth and width in the bed of a great river. It is contrary to its laws."

CURVATURE.—Under the head of Curvature, the former Chief Engineer of the Panama Canal lays great stress upon a question which has never received the attention which its vast importance demands. The canal is to be used for ships of the largest ocean size, of great length and slow maneuvering ability. It is well known that steering in shallow waters is difficult and unreliable, the currents set up destroying to some extent the normal action of the helm, hence curves should be as infrequent as possible, and where they exist they should have the largest possible radius. In examining the two proposed canals on this basis, we find the most extraordinary difference; for while the Panama route has twenty-five curves in a total length of curvature of 19.5 miles, the Nicaragua route has eighty-two curves of a total length of curvature of 53.5 miles. As regards the most vital question of radius, or ease of curves, we find that in the Panama Canal, with the exception of three curves of 8,200 feet radius, all are of 10,000 feet radius, or more, while on the contrary there are sixty-nine curves in the Nicaragua Canal below 8,000 reet radius, of which no less than fifty are of 3,000 and 4,000 feet radius. Regarding this feature, the author of the paper says: "It must be borne in mind that in that part of the canal which lies in the San Juan River itself, there will be nearly 28 miles excavated into the bottom of the river to a depth of 16 feet for the larger part, and that in this portion of the route there are forty-three curves of between 3,000 and 4,000 feet radius." He maintains that this sharply-curving channel, opened as it is down into silt and sand, will be extremely difficult to maintain, since it will necessitate constant dredging in a river which carries during flood-time 100,000 cubic feet of water, or one-quarter the amount which goes over Niagara Falls. "Obviously," says Mr. Bunau-Varilla, "ships will meet there an accumulation of extreme difficulties in the way of sharp curves, heavy river currents, constant strong winds and impediments either from the dredges themselves or from the sand and silt they will have to remove. . . . In Panama the large and easy curves, absence of winds, scarcity of currents and the rarity of floods give quite a reverse impression as to the eventual facilities offered for navigation."

HARBORS AND TIME OF TRANSIT.—With regard to harbors, the advantage is generally admitted to be with Panama, since two excellent harbors exist, one at each terminus. At Nicaragua, on the other hand, the Atlantic terminal is unsatisfactory, because of the enormous quantities of sand emptied into the sea by the San Juan River, and carried across the proposed mouth of the canal by the trade winds. The harbor on the Pacific will also have to be artificially constructed. Furthermore, two additional harbors will be necessary at the entrance and exit of the canal at the great inland sea of Lake Nicaragua. Were the two canals both finished and open to traffic, the time of transit by the 45-mile Panama Canal would be only twelve hours, whereas by the 183-mile Nicaragua Canal the time of transit will be thirty-three hours.

### AN INTERESTING AUTOMOBILE DAMAGE CASE.

A short time ago there was a trial before a jury in the Supreme Court of this city of a suit brought by Dr. George W. A. Collard, of Bridgeport, Conn., against Frederick C. Beach, of Stratford, Conn., owner of a Riker electric surrey, illustrated in the SCIENTIFIC AMERICAN of May 13, 1899, to recover damages estimated at $50,000 for injuries claimed to have been received in consequence of the electric vehicle frightening the Doctor's horse. The accident occurred about three years ago on the main road, thirty-two feet wide, over which run two trolley tracks connecting the town of Stratford, Conn., with the city of Bridgeport. Early one morning Mr. Beach's son and coachman, while traversing this road in an easterly direction, at a rate of about nine miles per hour, observed the Doctor's phaeton going the same way some five or six blocks ahead; the road at the time was free from other vehicles. When within three blocks of the phaeton it was seen to stop, and soon thereafter a commotion occurred as the Doctor alighted. He was observed to be thrown down and dragged along by the reins on the road about fifty feet before the animal was stopped. At once the Doctor arose and held his horse, while the electric vehicle, which had been approaching from behind, passed him at a moderate rate of speed and stopped a short distance away. The same animal had passed and seen the vehicle at other times previous to this occasion, and as no serious damage appeared to have occurred, the electric vehicle proceeded.

Afterward the physical injuries were claimed to be a slight dislocation of one finger and general nervous shock, disabling the Doctor from attending to his business.

One of the puzzling allegations in the complaint was that the electric vehicle was noiseless in its running qualities, but calculated by its peculiar appearance to frighten horses of ordinary gentleness. And it was claimed by the Doctor that the operator while approaching from behind should ring the signal bell. The evidence failed to sustain any ground of negligence on the part of the driver of the electric vehicle, and the jury decided, after a short deliberation, in favor of Mr. Beach.

In charging the jury, Justice Charles F. McLean made some very excellent remarks concerning highways, their uses and rights of vehicles to travel thereon. He said among other things:

"A man who brings another into court is bound to prove the very case he sets out, or fail, whether you or I think that he might have proven another case and made the defendant liable. The highways are for us all; all can use them, with reasonable regard, to be sure, for others who use them. You and I, in our experience, have seen a great change in the highways, not only in the highways of this town where we live, but in the highways out of town. They have become a great deal better, and the great advantage of bettering the highways is that people can exercise their right of locomotion more easily and accomplish more; that we can go to and fro and have our goods go to and fro much more easily and much more swiftly.

"In our experience we have seen vehicles change very much, and we see very different vehicles here from what we see sometimes when we travel abroad—very much better vehicles, we think; they are also a great advantage to the community, to us all, in that locomotion is easier and swifter.

"The most common motive power on the highway is a horse; but the horse has no paramount exclusive right to the road; and the mere fact that a horse takes fright at some vehicle run by new and improved methods, and smashes things, does not give to the injured party a cause of action. It is true, as in other cases, that the mere fact that an accident happens does not make it the fault of someone else and make it his duty to pay for it. When the highway is not restricted in its designation to some particular mode or use, it is open to all suitable methods, and it cannot be assumed that those will be the same from age to age, or that new means of making the way useful must be excluded, merely because their introduction may tend to the inconvenience or even injury of those who continue to use the road after the same manner as formerly.

"The case is to be determined upon the issues presented to you—is to be determined upon the facts as to whether the plaintiff has acted as would a man of reasonable prudence under the circumstances in which he was placed. He testified, as I recall, that his horse was a gentle horse. A witness testified for the defendant that he had met the plaintiff upon the road several times, that he had seen his horse standing by the roadside, and that the horse had been frightened.

"It is to be presumed that those who use the road know the uses to which the road is put, and that we should be aware, we who drive on the road should be aware that bicycles, that vehicles operated by other motive power than horse power or oxen use it, and that we should be upon the alert, reasonably on the alert, as to what dangers, if any, or surprises, if any, may come to us.

"Now, if the plaintiff perceived that this vehicle was in the road, he was bound to act as would a reasonable, prudent man with regard to his own horse, and that and the circumstance, if you believe it to be true,

THE BRONZE MEDALLION OF ROBERT FULTON.

that his horse had been frightened by such a vehicle before, was a circumstance that should be taken by him into consideration.

"Not only have the roadways improved very much within our experience, but the means of travel have improved very much also; and the fact that the introduction of new means of locomotion may inconvenience others is not usually a reason for inhibiting it. The prejudices of the 'road-driver' (a phrase very familiar to most of us in this town) are not to control the means of locomotion to be used by the public. Much has been said about the swiftness of the vehicle and about its relative freedom from noise. Within limits, freedom from noise is of very great moment to the whole community, not merely to the persons who use the vehicles, but persons living by the roadside and the persons who use the road. Within limits, too, the swiftness with which persons are enabled, by modern vehicles, to go from place to place, is of great moment also.

"If you come to the conclusion that both sides were at fault, the plaintiff in the management of his horse, or lack of precaution which he took, and the person who was operating the vehicle, then the verdict must be for the defendant, because the law will not apportion the fault between the two. If a man is at fault (so at fault that he helps bring about an accident) he cannot recover."

Mr. William McAdoo was counsel for the defendant.

S. T. Wellman, Pres. A.S.M.E. Prof. Thurston. Engineer in-Chief Haswell. Admiral Melville. Rev. Mr. Crary.

THE UNVEILING OF THE FULTON MONUMENT, TRINITY CHURCHYARD.

### THE ROBERT FULTON MEMORIAL.

The world at large, and even many of those who are interested in the history of mechanical engineering, do not know that the body of the great engineer, Robert Fulton, lies in Trinity Churchyard, in New York city, being interred in the Livingston family vault. There was no mark nor inscription to indicate the resting-place, although his memory is perpetuated by such familiar names as Fulton Street, Fulton Ferry and Fulton Market.

Now, however, the reproach that we do not erect memorials to our great men no longer obtains, in this instance, for the American Society of Mechanical Engineers has caused a monument to be built, carrying a medallion portrait of Robert Fulton. The attention of the society was brought to this matter some three years ago by Mr. Albert A. Hopkins, of the editorial staff of the SCIENTIFIC AMERICAN. The idea was warmly welcomed, and a committee was appointed to investigate the proper method to accomplish a suitable marking of the grave. Its efforts were heartily met both by the Trinity Corporation and by members of the family. This monument was unveiled on December 5, with appropriate exercises. At 2 o'clock the members of the society and their guests assembled in the Real Estate Exchange adjoining the churchyard. Rear-Admiral Melville, Engineer-in-Chief of the United States Navy, made the opening address, and he was followed by Prof. R. H. Thurston, of Cornell University, who in a few simple and well-chosen words gave a lucid idea of Fulton's real contribution to civilization. It was not claimed that Fulton was the actual inventor of the steamboat, but it is claimed that he was the first one to put it into commercial form, and that he was responsible for the proportioning of engine power to hull. Mr. Charles H. Haswell, who is now ninety-three years old, was present. We are carried well back to the beginning of the last century and to the very commencement of marine engineering when we realize that this venerable gentleman and engineer saw the "Clermont" making its first trip to Albany. Mr. Haswell was the designer of the second steam war vessel of the United States Navy, as Fulton was of the first. He was also the first engineer in the navy. The procession from the Real Estate Exchange was led by Admiral Melville and Mr. Haswell. The members and their guests passed out of the rear door into Trinity Place and through the churchyard into Trinity Church, where the regular memorial services were held. The full choir was present, and the address was made by the Rev. R. F. Crary, D.D., a grandson of the inventor. Admiral Melville's interesting address is published in the current issue of the SUPPLEMENT. After the services the visitors filed out of the church to the graveyard, where the monument was unveiled. The site is next to that of Alexander Hamilton's memorial on the Rector Street side of the yard. The monument stands 12 feet high and is of plain granite bearing a bronze relief of Fulton. At the foot of the granite block is a plain inscription:

TO THE MEMORY OF ROBERT FULTON.
Born 1765. Died 1815.
ERECTED BY THE AMERICAN SOCIETY
OF MECHANICAL ENGINEERS.
1901.

It is poetic justice that Fulton should continue to rest in the spot where he was interred, for at the front of the quaint old burying-ground run the electric cars, at the rear the elevated railroad, and at the foot of Rector Street, the other boundary, some of the fastest vessels in the bay make their landings. What more fitting spot could be obtained for the resting-place of one whose activities contributed in so large a degree to the progress which is so much in evidence immediately around the historic old church?

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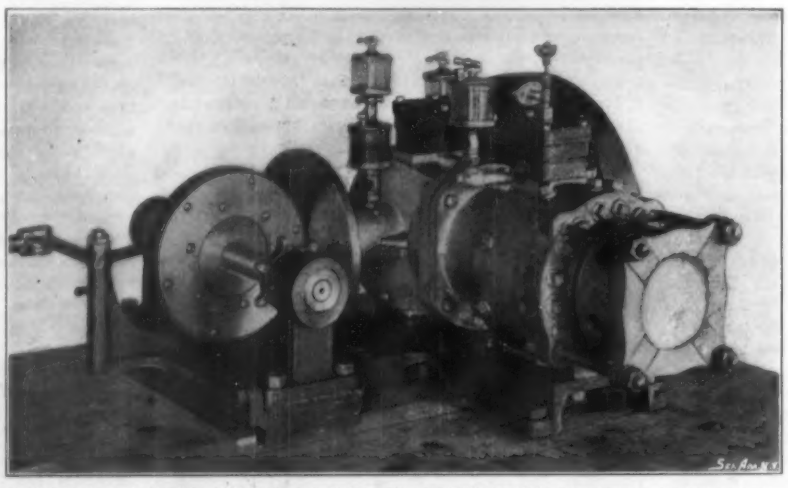
Recently The Times, London, sent a commissioner to Germany to spy out the land of machine shops, in order to ascertain the relative efficiency of the workmen therein as compared with English workmen. The commissioner seems to have been a competent man, for he has touched upon the salient features of the two races. The report states that the latest shops are well arranged, being light, well ventilated, and with all sanitary conveniences. The men themselves are cleanly in person, have steady hands, and take great interest in their work. They begin promptly at bell times and take no advantage of the foreman's absence; they are just as ready to start at the proper time as English workmen are to leave off. The tools are finely cared for and one man operates several, according to the nature of the work. German machinists are close workers to dimensions, and the cost of machining is said to be about one-half that of similar operations in English shops; in time the reporter must mean, for no mention is made of the rate of wages.

### THE INTERNATIONAL KEROSENE OIL MOTOR.

The advantages of a motor for power purposes which can be run by kerosene instead of by gasoline, and that, too, without the most troublesome feature of engines of the latter type—the electric spark—are apparent. Such an engine can be started with but little delay, and, once started, will continue to run as long as the fuel holds out. Common kerosene can be obtained at any country grocery store and is always of a uniform quality. Besides being thus everywhere obtainable, its slightly lower cost renders it not only a convenient but also a less expensive fuel for automobile use.

The inventor of the International motor, Mr. H. G. Underwood, aimed to produce an engine for automobiles, auto-trucks, cars, and marine purposes which should be as simple and practical as possible in construction and operation and at the same time be much smaller in size, lighter in weight, and if possible more compact than any other engine on the market.



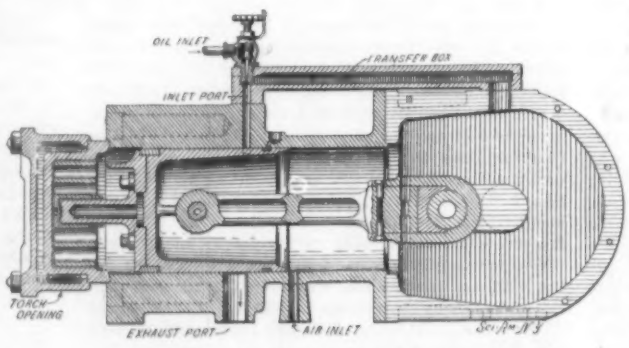
KEROSENE OIL MOTOR WITH FRICTION-DISK-TRANSMISSION FOR LIGHT AUTOMOBILES.

The engine is constructed on the two-cycle principle, and all valves are dispensed with by employing the piston to open and close the exhaust and inlet ports in the usual manner. In this particular engine the valve admitting the mixture into the crank case, where it is compressed slightly before passing through the transfer pipe or box to the cylinder above, is unnecessary, as the kerosene is fed through a needle valve (by gravity or air pressure) into the transfer pipe just opposite the point where the pipe joins the cylinder, and is carried directly into the cylinder by the compressed charge of air from the crank case. This air enters the crank case through a port uncovered by the piston when at the top of its stroke, and shown open in the sectional view. The company has also patented a two-cycle motor which does away with the crank case as an air chamber, thus making it possible to construct a multicylinder motor without dividing partitions in the crank case, which need not necessarily be inclosed. This is a distinctly new feature in two-cycle engine construction.

The charge enters the cylinder and is deflected upward by the deflector in the usual manner. A part of it is caught in the small auxiliary cylinder at the end of the cylinder proper when the auxiliary piston enters it after the main piston has traversed about half its stroke. This small charge is given a sudden, high compression by the auxiliary piston which fires it, owing to the head being in a heated condition. The flame passes through a small hole in the end of the auxiliary cylinder, then at right angles through a narrow passage communicating with a series of holes leading back to the cylinder proper. Passing through these holes it fires the charge in the main cylinder. By using the small piston to fire the charge, the inventor does away with the necessity of employing a high compression or a hot tube in the cylinder proper. The parts are sufficiently hot, after heating the head with a blow torch for five minutes, to explode the first charge, as a compression three or four times as great as that in the main cylinder is obtained in the small one, and after the first explosion the head is maintained in a heated condition by the constant firing of the mixture. The engine can be stopped and started again within fifteen minutes without reheating, but it is about as cheap to keep it running, as it consumes only a pint an hour per horse power, and can be run all day (a 2½ horse power motor) at a cost of about 25 cents.

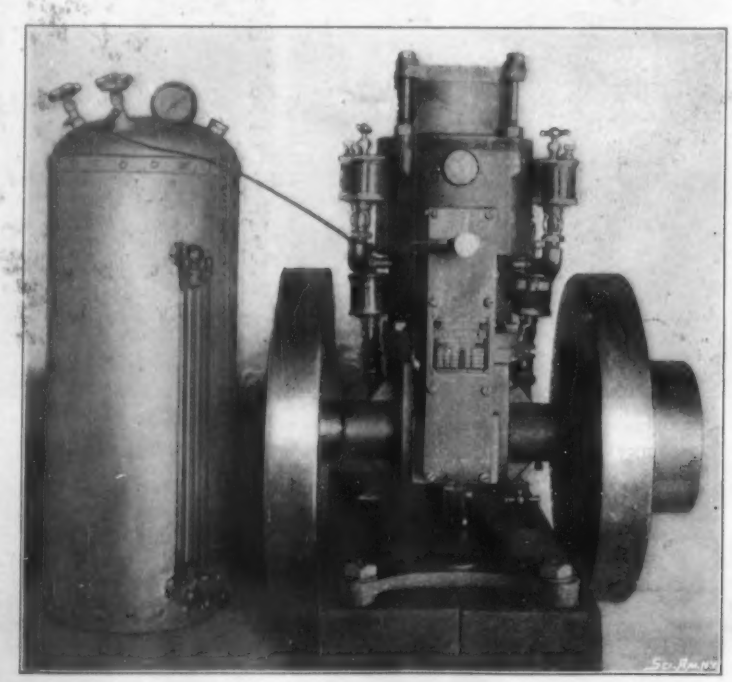
The International Power Vehicle Company, of Stamford, Ct., who manufacture this engine, have constructed an automobile delivery wagon run by compressed air, which is obtained from a small air compressor driven by one of their engines. The air is stored in a tank, from which it passes through the jacket of the motor before being used in the air engines, thus warming the air and cooling the cylinder of the motor without the use of water. Warming the air increases its volume and so increases the power obtained from the air engine, while this method of cooling is better than the usual one, since it dispenses with water and the necessary weight thereof and secures increased power through the process of cooling the cylinder, the heat from which is not utilized ordinarily, and is, in fact, lost energy when the cylinder is cooled by water. Enough air is kept stored in the tanks to enable the air motor to exert as much as 10 horse power for a short time if necessary. This arrangement does away with the fire, boiler, and visible exhaust of a steam carriage, while giving all the advantages of this otherwise excellent type. It is adapted particularly to heavy wagons, and weighs complete 500 pounds. For lighter vehicles the company has an improved friction disk transmission which transmits power direct from the engine, the latter being in this case controlled by a governor. This transmission has been in successful operation in boats for some time, and is a distinct improvement over other power-transmitting devices of this kind.

Judging from its simplicity, economy, and ease of operating, the kerosene oil motor has a promising future and will, when its merits become known, be used to a great extent for light power purposes.




CROSS SECTION OF KEROSENE OIL MOTOR.

The first award of the Osiris prize in 1903 will, we understand, be made by the French Institute. This prize is awarded to one who in the preceding three years accomplishes the most important work for science, industry, or literature, and is worth over $20,000.



INTERNATIONAL KEROSENE OIL MOTOR.

### The Inventive Genius of Connecticut.

The chosen home of Yankee notions, the State that takes out more patents than any other in proportion to population, reflects new luster upon its name in the census manufacturing returns, just published. Though forty-two States are larger than Connecticut and twenty-eight have more population, it was tenth on the list in the value of its manufactures in 1890; the statistics of the Twelfth census, when completed, are expected to show that the State holds its relative rank.

In 1890, says the New York Sun, to which we are indebted for the article, Connecticut beat all the other States in eleven important industries. In the last census period it has made a great advance in the production of all these commodities. There is little doubt that it retains its primacy in brass manufactures, for example, since it produced goods in 1900 valued at $48,526,868; with a product of only $22,309,894 in 1890 it had more than half the brass manufactures of the country to its credit. Everybody knows that this alloy of copper and zinc is surpassed only by iron in its general usefulness. It played a humble part in Connecticut, however, in the early days. When the Yankees there turned their attention to metal buttons they began to make brass, cutting the sheets up into buttons. That was the origin of the great brass industry of the State, Waterbury and other towns in the Naugatuck Valley turning out to-day more sheet brass ready for manufacturing than all the rest of the Union together. As the country had no need for all the buttons Connecticut was able to produce, brass wire was manufactured and worked up into pins; some inventive genius produced an automatic machine for making pins in 1841 and the industry thrived mightily. The State in 1900 made $1,761,806 worth of pins and needles, which is probably one-half or more of the country's production.

The histories of the State tell how Eli Terry, Chauncey Jerome, Gideon Roberts and other clock-makers, about the beginning of the last century, were accustomed to pack their saddlebags with clocks and peddle their wares through the country. The great clock industry dates from those days of small beginnings. Connecticut now produces about three-fourths of our home-made clocks, the product being worth $4,545,047 in 1900. We are exporting now about three times the value of clocks that we import.

Elias Howe, Jr., invented the sewing machine, establishing his factory at Bridgeport; the Wilson and other famous machines also originated in Connecticut, which, in 1900, produced sewing machines and attachments valued at $3,170,137. Goodyear accidentally dropped a piece of rubber powdered with sulphur on a red-hot stove and thus discovered the art of vulcanizing rubber. He gave the impulse that started the rubber factories at Naugatuck, making Connecticut one of the great rubber-working States, the product increasing from $3,476,398 in 1890 to $8,246,240 in 1900. Over a century ago the making of nails and other articles of small hardware was pursued in the State as a household industry. These manufactures were long ago transferred to the factories, which in 1900 produced hardware valued at $16,301,198. From a small beginning in Hartford, where the process of electro-silver plating was invented about 1846, sprang the great plants at Meriden Waterbury and other towns that in 1900 produced $9,538,397 of plated and britannia ware.

The total value of manufactured products in 1900 was $352,824,106, an increase of 42.1 per cent over the production of 1890. Large capital, abundant labor and good markets near at hand are among the advantages of Connecticut; but the State owes much of its success in manufactures to the frugality, industry and genius of the pioneers who laid for it the foundation of industrial greatness.

A judge has granted an order allowing a referee to take testimony as to the defective working of a voting machine in a Buffalo, N. Y., election district. It is alleged that the machine would not register a "split" vote.

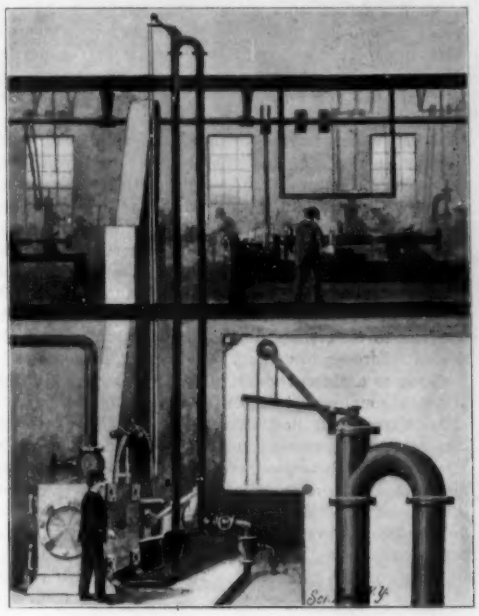
### SAFETY DEVICE FOR ENGINES AND CONDENSERS.

A safety device which is arranged to keep the engine cylinder completely free from water in case the engine should act as a pump and the condenser is at a standstill, is an ingenious invention for which Mr. Thomas Grieve, of Perth Amboy, N. J., recently received a patent.

The exhaust of the engine passes to a condenser by means of an inverted U-shaped pipe, the upper portion of which is about 34 feet or more above the level of the water in the condensing chamber, so that when the steam is shut off in the engine, and the piston continues to move by reason of the momentum of the flywheel, causing the engine to act as a pump, the water contained in the condensing-chamber will not be drawn into the engine by way of the U-shaped pipe, since the upper end of the pipe is above the suction height of the pump. The exhaust steam is condensed by a jet of water. The condensing-chamber is connected with the pump to remove the water, the steam being instantly condensed and a vacuum produced in the U-shaped pipe. Should the pumps stop at any time and a vacuum be produced by the engine, the water contained in the condensing-chamber cannot be drawn by way of the U-shaped pipe into the engine for the reasons given.

In the elbow of the pipe an outlet is arranged, which is shown in the detailed view of the accompanying illustrations, and is normally closed by a valve engaged by a lever from the free end of which a rope extends downwardly. When the engineer pulls the rope, the lever will swing the valve off its seat, so that the exhaust steam can freely escape through the upper end of the U-shaped pipe without passing to the condenser. This is done when the steam is not to be condensed, and the valve controlling the passage to the condenser is closed. But when the steam is to be condensed, the valve in the elbow is closed; and in order firmly to hold the valve to its seat until the desired vacuum is established by the action of the circulating pump, a second rope is provided, passing over a pulley held on a bracket, the upper end of the rope being connected with the lever. When the engineer pulls upon this second rope, the lever will be swung upward to press the valve firmly to its seat. The vacuum can be easily broken whenever it may be necessary by means of a valve or plug cock.

The principle underlying this invention can be applied for central condensing purposes, or for one air-pump used in connection with any number of engines, the condensing-chamber suction leading to one main suction and thus to the pump. This centralization of the condensing system by leading the exhaust steam



THE GRIEVE SAFETY CONDENSER.

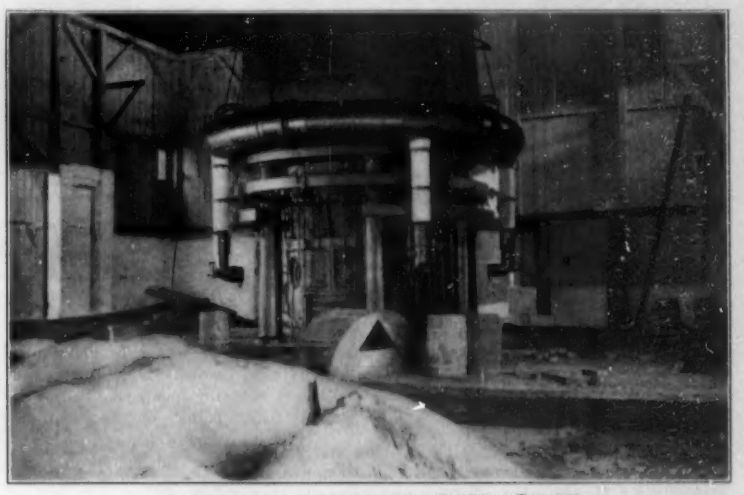
from each engine to one large exhaust in turn leading to the condenser, is commonly found in very large plants. The arrangement necessitates the employment of large expensive pipes and valves. With Mr. Grieve's system, the expense of installing this elaborate system of piping would be very materially reduced. Moreover, if the conditions were such that the condensing-chamber could be raised above the pump, the space below the condensing-chamber would be filled with water by gravity; and since every 2.3 feet of water are equal to one pound per square inch, and one pound is equal to 2 inches of vacuum, the pump would be relieved of that much work. Mr. Grieve has subjected his condenser to severe tests, and informs us that it works satisfactorily in every respect.

### IRON MAKING ON THE PACIFIC COAST

An event of no small importance is the recommencement of iron making on the Pacific Coast, which will take place shortly at Irondale, some five miles south of Port Townsend, Washington. Here, nearly one-quarter of a century ago, was erected the first blast furnace on the Pacific Coast. The venture, after being in operation for a matter of twelve years, proved a failure, and the plant was shut down. After the expenditure of a quarter of a million of dollars in prospecting and developing iron mines, experimental work with fuels, the installation of new machinery and the repair of the old plant, the Pacific Steel Company, a corporation in which practical iron-makers of Pennsylvania are the principal owners, is now in condition to commence work where the defunct Puget Sound Iron Company abandoned it twelve years ago.

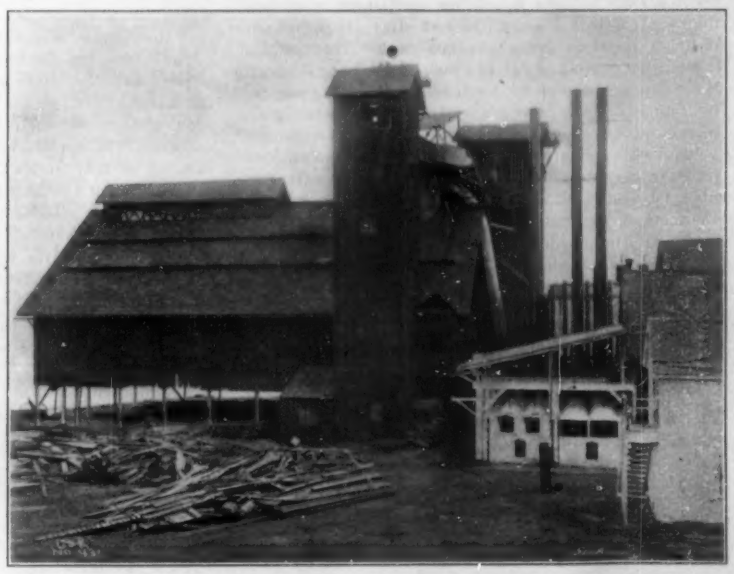
It is a fact that practically every pound of iron and steel which the Pacific Coast consumes or sends over sea to foreign markets is brought from points east of the Mississippi River; and it is claimed that at the present time competition with the iron works of the East is all but impossible, on account of the necessarily prohibitive freight rates on the raw materials. Some three years ago the present vice-president of the Pacific Coast Steel Company commenced an investigation of the iron mines on Texada Island, B. C., from which the ore used in the abandoned plant had been brought, and also thoroughly examined the coke and charcoal made on Puget Sound. Many tons of various Pacific Coast coals were sent to McKeesport, Pa., and there coked side by side with Pennsylvania coals, and the results compared. As a result of these investigations, the vice-president, Mr. Swaney, purchased the abandoned plant of the Puget Sound Iron Company, and work was opened up once more at Irondale. The furnace was relined, the machinery for crushing and hoisting ore was overhauled, and the steam plant improved with a view to securing more economical power production, this refitting being car-

Ore-Bunkers on the Wharf.



The Blast Furnace, Showing the Hot-Blast Tuyeres.

Row of Charcoal Burners.



Rear View of Plant, Showing Charging Platform of Furnace and the Boiler Plant.

IRON MAKING ON THE PACIFIC COAST.

ried out under the direction of the Wellman-Seaver Engineering Company, of Cleveland, Ohio.

The blast furnace, which is shown in two of our illustrations, is 50 feet in height, 12 feet in the bosh, 6 feet on the crucible, and has a capacity of 50 tons of iron per day. A battery of four steam boilers furnishes power to drive the ore-crushing and hoisting machinery and the blowers. The gases are conducted from the top of the furnace by a large pipe and are led into the boiler house, where they are burned under the boilers in the manner customary in our Eastern plants. Hot blast is used, the air entering the furnace through the five tuyeres shown in the illustration, at a temperature of from 900 deg. to 1,000 deg. The water for the supply of the furnace and steam plant is led by a wooden flume from Chimacum Creek, the flume being 3½ miles in length.

For the present the Irondale blast furnace will make use of the same grade of ore that was used when the plant was first in operation. This ore is brought on scows from Texada Island, British Columbia, which is 130 miles distant, and the Texada ore will be used until the value of the company's own mines has been determined. Moreover, the coke will be brought on scows from the Skagit Coal and Coke Company's ovens. Other cokes from Pierce County and British Columbia will also be tested experimentally. After the experimental work with coke is completed, it is the intention to run the Irondale furnace entirely on charcoal, and hence a great deal of attention has been given to the charcoal-making plant. The kilns of the former company will be used, but a large sum has been expended in improvements and additions and the new company expects to produce fuel at a considerably lower cost than at present.

The charcoal-burning kilns, which were built at a cost of $40,000, are twenty in number. They stand in a double row just east of the main building. They are built of brick, bound with iron bands, and covered with concrete. Each kiln is 30 feet high and 30 feet in diameter at the base, and will hold 75 cords of wood. Originally the kilns were filled by hand, but appliances are now being erected which will automatically feed the kilns with wood, ready for burning, at a cost of fifty-four cents a cord. The log "culls" and "seconds" unsuitable for sawing into lumber will be purchased of the large logging companies on the Sound, towed to the furnace, and placed in a boom in front of the charcoal kilns. The logs will then be towed to a logway by a workman, and from that time until it is taken from the kiln as charcoal there will be no handling of the wood. It is considered that a very promising feature, judged from the standpoint of economy, at this plant, is the cheapness of water transportation and the short distance over which the ores and fuel will have to be brought to the blast furnace.

Although the plant is not a large one, it is large enough to afford a thorough test of the problem of economical iron making on the Pacific Coast. Should it prove successful and lead to the development of this most important industry on a large scale, it would prove to be a factor in the development of the Pacific Coast second only in importance to the construction of the trans-continental railroads.

### Infra-Red Spectra of the Alkaline Metals.

M. Hans Lehmann, a German physicist, has lately made a series of researches upon the infra-red spectra of the alkaline metals, in which he uses the photographic method with success. He thus designed to complete the former work of Snow and Lewis in this direction. To make the plate especially sensitive to the red rays he uses a solution containing alizarine, nigrosine, ammonia and nitrate of silver, in which an ordinary gelatine plate is immersed. This makes it sensitive to rays as far as 1,000 $\mu$. He has also used the solution proposed by Burbank, containing cyanine, hydrate of chloral and methyl alcohol together with nitrate of silver and ammonia. The plates are developed with oxalate of iron, using a small quantity of bromide of potassium. The luminous source is furnished by an electric arc formed between two rods of the metal to be studied. A screen formed of a concentrated solution of bichromate of potassium in sulphuric acid absorbs all the rays whose wave-length is less than 520 and allows those of greater wave-length to pass. A two-prism spectroscope was used, provided with a total reflection prism and a plane mirror. The photographs thus obtained were examined according to the data previously furnished by Abney, Becquerel, Snow, Lewis, Kayser and Runge. The principal rays of the infra-red spectra of rubidium and cæsium are given as follows:

| Rubidium. | Cæsium. |
|---|---|
| λ = 851.588 | λ = 931.186 |
| 793.045 | 917.138 |
| 780.599 | 894.992 |
| 775.359 | 876.610 |
| 762.692 | 858.772 |
| 740.679 | 808.302 |
| 739.702 | 801.962 |
| | 761.658 |
| | 722.748 |

### An Improved Hay Stacker and Builders' Derrick.

In our issue of April 20, 1901, we described a novel hay stacker patented by Marvin C. Hutchings, of Bozeman, Mont. Mr. Hutchings has since improved his invention with the result that the serviceability of the stacker has been very considerably increased.

As our illustration shows, the derrick is held in place by two guy ropes, the upper ends of which are bifurcated for attachment to the ends of the derrick members. One guy rope is securely attached to the ground; the other is provided at its lower end with a weight, sufficiently heavy to draw the derrick back to its normal position whenever it is inclined. The weight serves to bring the derrick back when the load has been discharged. This weighted guy rope passes over a friction roller which, as shown in Fig. 2, is located in a slot formed in the head portion of an anchorage arm. The anchorage arm is supported by connected legs held to turn in a socket adjustably mounted on the body portion of the anchor arm. By reason of this construction, the anchor arm can be carried to or from the ground in order to give the weight more or less drop. The socket in question is secured to a sleeve, which is held in place by passing a pin through apertures in the arm.

It is frequently desirable to check the movement of the weighted guy rope, and to that end a brake is provided, which is mounted on the bottom of the upper end of the anchorage arm, and which is clearly illustrated in Fig. 2. The brake consists essentially of a plate sliding in guides, which plate is formed with an opening corresponding with the opening in the head of the anchor arm. At the rear end of this

IMPROVED HAY STACKER AND BUILDERS' DERRICK.

opening a brake-tongue is formed, which extends forwardly and is arranged to engage the guy rope passing over the roller. The plate is controlled by a coiled spring secured to the anchor arm, which spring serves to draw the plate to its normal position after it has been carried into engagement with the guy rope. The brake is operated by a cord passed through rings supported by the weighted guy rope. The end of the brake cord terminates in a handle which hangs over the load of hay to be stacked, so that the handle is always in easy reach.

The brake can be brought into action whenever it is required. The main object of this brake is to check the derrick and prevent its tilting to the stack too soon, and thereby delivering the fork to the hay too quickly. The brake can also be used to control the rapidity of the derrick's motion to or from the stack.

The sides of the derrick are extensible and are held in position by wire cables winding on drums, so that the sides can be raised or lowered. The base is adjustable, so that its width can always be made to conform with the height of the derrick.

The invention is not exclusively intended for use as a hay stacker, but is equally serviceable for builders' purposes.

The fiftieth scientific anniversary of M. Berthelot (he began his career as a chemist in 1851) is to be commemorated by the presentation to him of a metal plaquette by his colleagues of the Institute of France. On the front of the plate, which is the work of Chaplin, the engraver, the recipient's portrait will be reproduced in profile, and on the back M. Berthelot will be portrayed seated at his laboratory table, "Truth" illuminating him with a torch, and "Patrie" protecting him under a flag and offering him a crown of laurels.

## Correspondence.

### A Universal Language.

To the Editor of the Scientific American:

In your issue of December 7 Arcadius Avellanus of Philadelphia says the world should adopt Latin as the universal tongue of cultured people. That no one knows how Latin was pronounced, exactly, is a serious objection. But even laying that aside and pronouncing it some way or other, as the world does, what is the use of learning a language that not a thousand people in the world now speak, when there is already an international language spoken by forty or fifty millions at the very least?

There can never be a universal language. There is a physical reason for it. Give the English language to the Chinese, and come back in a century and you would not know it. The vocal organs are so different in different races that a language will change too greatly for the different races using it to understand each other. Furthermore, people in the North speak so as to keep the cold air in winter from going into their throats. This is especially the case with Russians. This is why the Northman says *hem* (hame) and the "High" or inland German says *heim* (hime). One is in a cold climate and speaks with the lips nearly closed, the other in a mild climate where it is as good a thing to get warm pure air into the mouth as into the house. French comes nearer to being a compromise language for use in cold as well as warm climates than any other language, perhaps because the French are a mixture of the Baltic white and the Mediterranean brunet races. At the same time I learned by dear experience in tie and lumber camps at great altitudes and low temperatures in Wyoming and Utah that it is deadly to open the mouth wide in talking outdoors in winter. I learned that the French stand the worst cold as well as they stand the heat of Algiers. But even their language is affected, and *froid*, cold, instead of being spoken liberally as *frwahd*, ending with the mouth open, is cut to something as short as and nearly like *fret*, spoken with nearly closed lips.

Though the dialect of "Low" or coast German that we call English (from the Engoa or plainsmen of ancient Denmark and other Baltic shores) is my mother tongue, I can read to myself in French faster than in it, and it is in the language, not in me. English as spoken in England and Scotland is so far from our form of it that I understood Germans speaking their own tongue better than I understood the English of England and Scotland. English can never become the universal language; French could as nearly as is possible for any.

It is a pity for a large number of persons to dissipate or expend a vast amount of energy in attempting the impossible—such as a universal language. It would not stay universal, but would break up into dialects recognizable as akin only by keen philologists.

In gathering material for my "Principles of the Science of Money," I found several of the words in commonest use in the tongues of the branches of the Baltic races come from originals on the Babylonian tablets. And if the "Slav theory" of Gesenius is true, perhaps they were received from the north of the Caspian from the blue-eyed blonds in Siberia before they were handed back to their kin in Denmark by Phenician traders.

George Wilson.

Lexington, Mo.

### Award of the Nobel Prizes.

The award of the Nobel Science Prizes has just been announced as follows: Physics, Prof. Roentgen, of Munich; chemistry, Prof. Vanthoff, of Berlin; medicine, Dr. Behring, of Marburg, and literature, M. Sully-Prudhomme, of Paris. The recipients will each receive 208,000 francs.

The Nobel prize for the persons who had most benefited humanity during the past year is to be equally divided between M. Dunant, the founder of the Geneva Convention Red Cross Society, who is now very poor, and M. Passy, a French deputy and peace advocate. The announcement of the peace prizes in the Storthing was made the occasion of speeches paying tributes to M. Nobel and exalting peace. M. Lovland, Minister of Public Works, said he hoped the proceedings would encourage the nations and national assemblies to cooperate in promoting peace and arbitration. In the evening Crown Prince Gustav presented the prizes.

The first town in England to effectively display the possibilities of the motor fire engine for fire brigade purposes is Eccles in Lancashire. The engine was constructed by a local firm and has proved a conspicuous success. It carries five men, 300 yards of hose, two standpipes, scaling ladders, jumping sheet, and other necessary apparatus. It is propelled by a 6 horse power electric motor. It is remarkably silent in motion, and averages a speed of 14 to 16 miles per hour on the level. It has also established its ability for climbing stiff gradients with facility.

### Engineering Notes.

The contract for building the largest cantilever bridge in the world has been awarded by the Wabash Railroad. The new structure will span the Monongahela River from the foot of Ferry Street to the south side and will permit the Wabash to enter Pittsburg.

The project of draining the Zuider Zee has been withdrawn from the States-General by the new ministry, thus being disposed of probably for a long period. The state of the Dutch budget renders such an undertaking at this time unadvisable; besides, the fall in the price of land has diminished the demand for new agricultural holdings.

A new ingenious contrivance for consuming smoke is being utilized in Berlin. When applied to a furnace it saves coal and consumes all the smoke. It has already been applied to several large engineering works in Germany with complete success. The German Naval Department has been submitting the device to severe tests upon a torpedo boat, and the results have been so satisfactory that it is proposed to adopt the system throughout the service.

A small experimental smelter has just been erected at San Diego, Cal. This will use as an experiment oil as a fuel in the reduction of copper and all other smelting ores. Mr. Trapp, the inventor, has perfect confidence in its success. In the ordinary smelter coke has been considered a necessity in smelting, as it generates great heat and has a chemical action on the ore. Shipments of iron and copper ore have been made to the new smelter and experiments will be started at once.

Under date of July 8, 1901, Consul-General Holloway writes from St. Petersburg: The city of St. Petersburg has decided to invite bids for a bridge over the Neva River, near the Winter Palace, to replace the pontoon bridge so long in use at that point. Its length is 847 feet and width 91 feet; the cost is limited to 3,500,000 rubles ($1,802,500). The specifications will be ready September 1, 1901, and the bridge must be completed in one year from that date. There are now two prominent bridges over the Neva—one stone and one iron—about completed.

The American Bridge Company, of Philadelphia, has obtained a contract for the construction of twenty steel bridges along the line of the Uganda Railroad in East Africa. The amount of the contract is about a million dollars. Several English and continental firms offered bids, but the Philadelphia company's bid was not only the lowest, but guaranteed the completion of the work in a shorter space of time than its foreign competitors. The new bridges will replace wooden structures which were built several months ago and were found to be inadequate for the service.

An interesting paper on "Comparison of Recent Battleship Designs" was read on November 15 before the Society of Naval Architects and Marine Engineers, which held a meeting in New York, by Naval Constructor H. G. Gillmor, U. S. N. As the most approved examples of battleship construction he named the United States battleship "Virginia," the British "Duncan," the German "Wittelsbach," the Russian "Borodino," the Italian "Vittorio Emanuele" and the Japanese "Mikasa." By a system of percentage values, the speaker reduced them all to a status of relative naval merit which placed the Italian at the head of the list, the American second and the German following.

The Department of State has received from Minister Merry, of Managua, under date of September 27, 1901, translation of a note from the Nicaraguan Minister for Foreign Affairs, giving notice that in accordance with Article XX. of the treaty of amity, commerce, and navigation, and Article VII. of the convention of extradition concluded between Nicaragua and the United States, the former treaty will expire at the close of twelve months and the second six months from the date of receipt of this notice. This denunciation, it is stated, in nowise affects the friendly relations existing between the two countries, and the Nicaraguan government desires the conclusion of new treaties.

In the opinion of Prof. Thurston the gas engine is a formidable rival of the steam engine, and is capable of further development. Each has given a horse power for about one pound of coal and the efficiency of both, between the coal pile and the point of delivery, is about 20 per cent. The steam engine, he says, has so nearly reached its limit that further progress under commercial conditions would seem to be very slow, but its range may be increased by employing very high pressures and superheating combined with them. In Sibley College work, 1,000 pounds per square inch have been used, and Prof. Thurston expresses the view that twice that pressure may be successfully used eventually, or with sufficient experience in its management. These factors would raise the efficiencies nearly 50 per cent, and reduce the coal per horse power hour to about three-fourths of one pound.

### Science Notes.

The Manufacturers' Club of Philadelphia has passed a resolution indorsing the metric system, and a memorial will be sent to Congress urging its general adoption by the government.

The jubilee of the fiftieth anniversary of the scientific debut of M. Pierre Marcelin Berthelot, which took place on November 24, almost reached the proportions of a national affair. The ceremony took place at the University of the Sorbonne, and among those present were the President of the Republic and a number of the members of the diplomatic corps.

The gathering of cigar butts is to be suppressed, according to an ordinance recently passed in the Council in the city of Chicago, Ill. The penalty for violation of this ordinance has been fixed at a fine of not less than $10 nor more that $100 for each offense. The law covers the manufacture of cigars, etc., from tobacco thus collected, and no one shall buy or receive such material. There is a movement on foot in New York and other cities to prohibit this nefarious practice.

The Italian government has purchased the celebrated Ludovisi Boncompagni Museum, the most important private collection of antiques existing in Rome, at a cost of $280,000. The purchase price represents about one-third of the value of the museum, which is now open to the public, in the baths of Diocletian, in Piazza Termini. It is intended to gather the many interesting museums of Rome in the Villa Borghese, converted into a National Museum of Italy.

A site has been secured in Washington, D. C., for the building of the Bureau of Standardization. It is what is known as the Children's Home site on Pierce Mill Road west of Connecticut Avenue. Twenty-five thousand dollars, which is the entire amount of the appropriation available, was spent for the site. The latter is said to be particularly adapted for the purpose, being entirely free from mechanical and electrical disturbances, and at a sufficient elevation to meet the requirements of atmospheric conditions. Two buildings, to be erected at a cost of $250,000, have been authorized, and will be begun at once.

The English Antarctic exploration vessel "Discovery" is proving unsatisfactory. Her journey from London to Cape Town proved that she is not a very good sailer. She consumes a great deal of coal, and makes little progress in a head wind. She also leaked badly on the voyage out, and it became necessary to shift all her cargo for repairs. This work proved a severe task to the crew in a tropical sun, but fortunately fine weather prevailed, so that the repairs were effected satisfactorily. A relief ship is going to be sent out to the "Discovery" at the end of her first winter in the Antarctic, and for this purpose a Norwegian whaling vessel has been purchased and is now being fitted up.

Some consternation has been caused among the passengers of the Central London Electric Railroad by the assertion of the Lancet that the air in the tube contains carbonic acid gas of nearly double the amount fixed as the limit of impurity. According to the Medical Officer for Marylebone, Dr. Wynter Blythe, who has analyzed the air at several stations, has found that the carbonic acid gas was not less than 10.3 parts per 10,000, while in the tunnel itself it reached 11.9. These figures have occasioned considerable surprise among the officials of the railroad and steps will be taken to purify the atmosphere. Passengers, it is remarked, persistently complain that the air is oppressive, when, as a matter of fact, the change they notice is really due to the temperature, which is much higher in the tube than it is, at this season, in the open air.

Although the plague and the practical failure of the monsoon have exerted a depressing influence upon both the export and import trade of British India during 1900, the value of the imports was in excess of that of either of the two preceding years; while the exports, though smaller than the two preceding years, were greater than any year previous to 1898. The most important decreases were in metals, machinery and railway material. The trade in matches has greatly increased, but the British article has almost disappeared from the market owing to the spirited competition of the enterprising Japanese. The Japanese matches are cheap, which is a vital consideration to the Hindoo. Great Britain is the principal market for India with 63.8 of the total trade. But whereas Great Britain's share is less than it was in 1899, so also is that of the United States and France, while all other countries have slightly improved their position. With regard to the tea industry, which constitutes the principal export of the country, the Indian growers are establishing markets in other colonies beyond Great Britain, which is still, however, its greatest customer for this commodity. The success of this enterprise is adequately demonstrated by the fact that the increased consumption of Indian tea outside British markets between 1896 and 1900 was over 14,000,000 pounds.

### GIANT SAND WHEEL FOR THE CALUMET AND HECLA MINING COMPANY.

One of the mines of the Calumet and Hecla Mining Company on Lake Superior is to be equipped with a sand or refuse wheel which will be the largest of its kind in the world. The wheel, which is now being constructed at the plant of the Robert Poole & Son Company, of Baltimore, has a capacity for carrying 550 sand buckets on the inner surface of its rim, and as the wheel will make ten revolutions in a minute, it will remove 5,500 buckets of refuse in that time, the contents of each receptacle being dumped into a trough to be located at the top of the wheel, in which it will be carried off by sluice water. The wheel measures 65 feet at its greatest diameter, and its estimated weight, exclusive of bearings and supports, is 50 tons. The axle or shaft, which was forged at Krupp's Essen factory, is 27 feet long, 32 inches in diameter, with a 26-inch hole through the center, and weighs 42,000 pounds. All of the finishing work on it was done in Baltimore.

One of the first requisites for building such a structure was a pit in which the completed portion of the wheel might be sunk as it was put together; and it was found that the Poole Company had one suited to the purpose, the pit being 100 feet long, 12 feet wide and 30 feet deep, while the building over the pit is so high that it easily accommodates the completed wheel.

The wheel was built in twenty segments. The rim is box-shaped in cross-section, with the toothed rim cast separate, in segments, and bolted to the wheel by inwardly-projecting flanges.

The structure is built on the same principle as the early bicycle wheels, which were commonly known as "spider" wheels. Toward each end of the shaft are two massive cast-steel hubs, and from these radiate forty steel arms or rods. The rods are arranged in pairs, and at the rim each pair connects to a pair of plate-steel lugs, which are riveted to the inner face of the rim, the outer ends of the arms being formed with an eye and secured to the lugs by means of an eye-bolt. The adjustment of the tension of the rods and the truing-up of the rim are accomplished, as in the old spider-wheel bicycle, by means of threads, nuts and lock-nuts on the ends of the arms where they engage the hubs. A good feature in the design of the wheel is that the stresses are all accurately determined, the arms, for instance, simply being subjected to a tensional stress and not having to resist the tangential stresses due to the load of sand in the buckets at the periphery. These tangential stresses are taken up by means of a system of tangent spokes and tie-rods which extend from the lugs on the rim, already referred to, to the periphery of a tangent-hub, which is keyed at the center of the shaft within the wheel. These tangential rods are arranged in pairs and in opposite directions, so that whether the tangential load at the periphery be right-handed or left-handed, there will be no transverse bending stresses on the main spokes or arms of the wheel. There are turnbuckles in the center of each tangential tie-rod, to enable the tension to be accurately adjusted.

One of the most interesting parts of the work on this wheel is the cutting of the teeth on the outside rim. For this purpose a special milling machine has been constructed, which is set up facing the teeth in the position shown in our illustration. When it is in position at the mine, the wheel will be driven by an electric motor of about 700 horse power.

### The Charleston Exposition.

S. C. Mead, president of the New York State Commission which has just returned from a visit to the South Carolina Interstate and West Indian Exposition, said to-day: "We were very much surprised at the extensive plan and scope of the Charleston Exposition. It exceeds Atlanta and Nashville. As far as the beauty of architecture and of the surroundings are concerned, it will be one of the grandest expositions since the World's Fair.

"Charleston is certainly to be congratulated upon its courage in undertaking an exposition of this magnitude. Out of the city's population of 60,000, only 25,000 are whites. This means that there are only 5,000 or 6,000 men upon whose shoulders must fall the burden of financing and carrying through the Exposition. Yet this they are doing successfully.

"As far as we can ascertain, the New York merchants and manufacturers do not seem to be properly represented among the exhibitors. It would seem as though an opportunity of this sort to bring before the people of the South the products of New York ought not to be lost by our New York merchants and manufacturers.

"The New York State Building is just about completed. It is undoubtedly, next to the Art Gallery, the most beautiful building on the grounds, from an architectural standpoint. It is the purpose of the commission to make this building a center of social attraction, thereby appealing to one of the dominant characteristics of the South, namely, hospitality."

## MEASURING THE HEAT OF THE STARS.

BY MARY PROCTOR.

That the heat of the stars can be measured, has been proved by Prof. E. F. Nichols, of Dartmouth College, who has invented a delicate sensitive instrument known as the radiometer and specially designed for this purpose. In 1898, Prof. Nichols was invited by Prof. George E. Hale to come to the Yerkes Observatory and experiment with the radiometer, the fine equipment of the observatory being placed at his disposal. The invitation was accepted, and Prof. Nichols spent the two summers of 1898 and 1900 in perfecting his invention and testing its capabilities.

The case of the instrument was made of a block of bronze, which was bored out to receive it, the block being about two inches square and four inches long. The case was perfectly air-tight. The radiometer suspension or torsion pendulum was built up on a thread of fine drawn glass 32 millimeters long, to the lower end of which was attached a very small plane mirror, 2.2 by 3 millimeters, made by silvering a fragment of very thin microscope cover glass.

To the upper end of the drawn glass was attached a very fine quartz fiber 32 millimeters long, the upper end of the fiber being made fast to a bit of steel wire, which passed up through a small hole in the axis of the torsion head (*a*, Fig. 1). The torsion head which carried the upper end of the suspension was in turn carried on a small square block (*b*, Fig. 1), free to slide in a slot in the bridge (*c*, Fig. 1), permitting the suspension to be brought closer to or withdrawn from a fluorite window in the front of the case.

On the axis, two-thirds of the way above the mirror, and in a plane at right angles to it, a delicate cross arm of drawn glass was fastened, having on its two extremities the two blackened radiometer vanes (*d d*, Fig. 1). The sensitive vanes were circles about 2 millimeters in diameter, which to secure lightness and uniformity, were stamped out of thin mica, with a circular steel punch made for the purpose.

The vanes were uniformly coated with lamp black, and mounted as symmetrically as possible with reference to the axis of rotation (*E F*, Fig. 1). The distance between the centers of the vanes was 4.5 millimeters, and they were placed from 2.5 to 3 millimeters behind the fluorite window. A piece of good plate glass was cemented over the opening in the side of the radiometer case, through which the deflections of the suspension could be read by the telescope and scale method.

The rays of the star projected from a condensing mirror (*F*, Fig. 2), entered the radiometer by passing through the fluorite window, and could be directed to fall on one of the blackened surfaces of the suspension vanes behind the window. Through a window in the back of the case, the star image in the radiometer and the blackened vanes of the suspension could be seen at the same time.

The heat rays of the star falling on one of the vanes warm it slightly, and in accordance with a principle discovered by Prof. Crookes a surface in a partial vacuum so warmed tends to back away from the source of heat. The suspension is thus slightly rotated as the fine quartz fiber offers little resistance to any force tending to twist it. It was in terms of this twist of the fiber caused by the different star images that the heat sent us by the stars was compared.

The experiments with the radiometer were made in the heliostat room of the Yerkes Observatory, which has been purposely designed for work of this kind. The gallery to the left of the double partition is provided with a movable roof and sides which slide back between the walls of the inclosed room to the right, leaving only a low parapet above the level of the floor. The only openings through the double partition are, a window large enough to admit the beam from the heliostat (at *H*, Fig. 2), and a passageway closed by double doors.

The beam of starlight from the heliostat was thrown upon a two-foot concave mirror (*M*, Fig. 2), of 7 feet 9 inches focal length, and the converging cone was caught on a small 45 deg. flat mirror (*F*, Fig. 2), four by six inches, and directed thence into the radiometer case (*R*, Fig. 2), passing through the fluorite window, the focal point lying in the plane of the vanes.

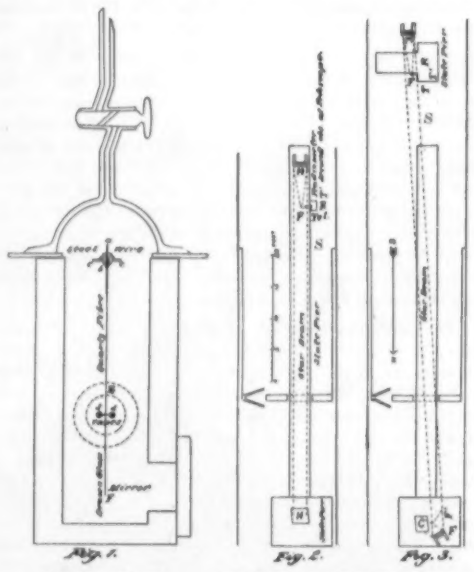
The radiometer (*R*, Fig. 2) was mounted on a wooden table, standing on an overhang built out from the long slate pier shown in the diagram. An observer at the telescope (*T*, Fig. 2) read the deflection of the radiometer suspension in millimeter divisions, on a reflected scale at *S* (Fig. 2), behind and above him at a distance of about 6 feet from the radiometer.

Cords connecting the slow motion on the heliostat were brought to a point within convenient reach of a second observer at the telescope (*T'*, Fig. 2) which was

RADIOMETER VANES.

focused on the sensitive vanes as seen through the rear window. The latter observer could keep the star image constantly in sight, except when it fell upon one of the vanes, in which case a very small quantity of stray light in the image showed its position.

With an observer at each of the telescopes *T* and *T'* (Fig. 2) the observer at *T* watched the motion of



RADIOMETER. HELIOSTAT AND MIRRORS.

*H*, heliostat; *M*, mirror (concave); *F*, flat mirror; *T*, telescope; *T'*, second telescope observer; *R*, radiometer; *S*, scale; *C*, coelostat; *F'*, plane mirror.

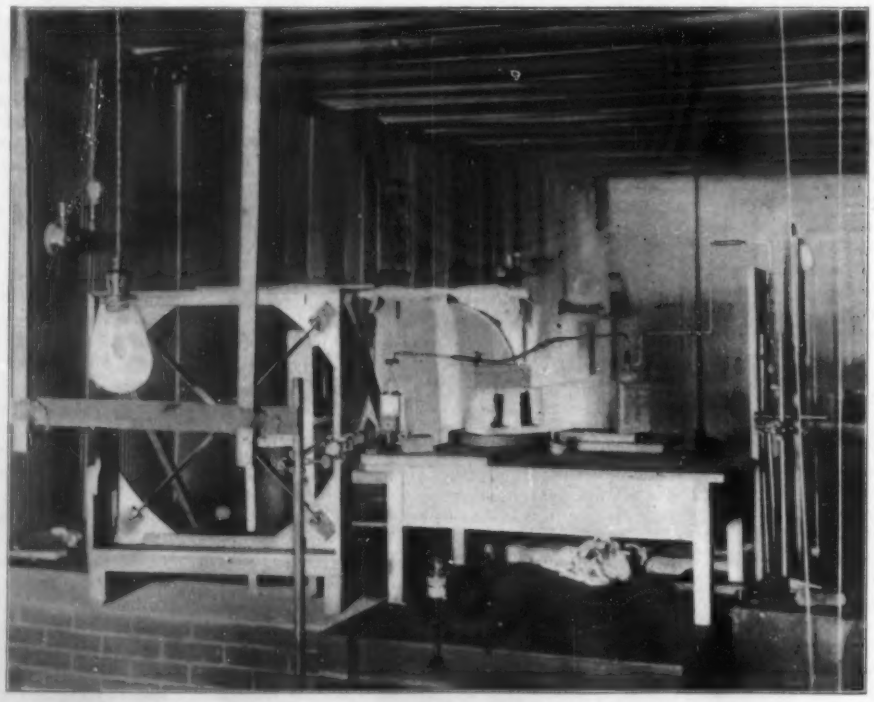
the radiometer, and waited for a period of comparative quiet which would bring the image of the scale to rest, then signaled to the observer at *T'* to throw the star image on the vane or off it, as the case might be, by means of the cords running to the slow motion of the heliostat. After a suitable time the radiometer deflection was read. Thus a series of "on" and "off" observations were taken and averaged. The results were quite uniform, the radiometer vane showing about the same deflection at each observation of the same star, or object under examination. In this way, Prof. Nichols experimented again and again with the bright stars Arcturus and Vega. The averaged results were quite uniform, the radiometer vane showing nearly the same average deflection in each series of observations.

In the second series of observations, made in 1900, the heliostat was replaced by the heavily mounted coelostat, used by the Yerkes Observatory at the total eclipse of the sun, May 28, 1900, at Wadesboro, N. C. The coelostat was driven by the clock of the 12-inch Kenwood telescope. The same plane mirror used in 1898 with the heliostat, was resilvered and mounted on the polar axis of the coelostat.

The change to the coelostat made the use of an additional plane silvered surface necessary, to direct the beam to a 24-inch concave mirror. The position of the new vertical plane mirror depended upon the declination of the stars observed. In the diagram (Fig. 3) *C* shows the position of the coelostat, *F* the position of the vertical plane mirror when used in observations of Jupiter and Saturn, and *F'* its relative position while used in observations of Arcturus.

The remaining parts of the diagram (Fig. 3) correspond to that in Fig. 2, with the exception of the radiometer which was mounted farther back in the covered gallery, than in the arrangement made in 1898. Plate I. shows the radiometer in this position and the 24-inch mirror used in measuring the heat rays of the stars and planets.

To test the sensitiveness of the instrument, some convenient standard of reference was required, and Prof. Nichols used a common paraffine candle as a basis for his experiments. The radiometer having been thoroughly tested by means of these experiments, it was used to measure the heat of the stars Arcturus and Vega, and the planets Jupiter and Saturn with the following results. The quantity of heat sent from Arcturus was found to be somewhat greater than the heat which would be received at a given point from a candle six miles away, if none of the candle's heat were absorbed by the atmosphere. Observations on Vega showed that it radiated about one-half the amount of heat received from Arcturus. The planet Jupiter sends us about twice as much heat as Arcturus, while we receive from Saturn only heat enough to equal the unabsorbed radiation of a candle ten miles away.



RADIOMETER AND 24-INCH MIRROR USED IN MEASURING THE HEAT OF THE STARS AND PLANETS.

### Chinese Shipbuilders.

Mr. W. G. Winterburne, who has resided in China for many years, recently read a paper before the Institute of Marine Engineers, England, which contained some facts of interest concerning the ability of the Chinese as shipbuilders and shipwrights, which will serve to dispel previously formed impressions of many in the direction indicated. In the type of trading vessel built to-day in China there is little or no departure from the practice of thousands of years; the junk still remains in use for general trade, and is likely to for some ages to come. It answers the purpose intended and is good enough to go to sea with for considerable distances, so Chinese vessel owners do not see any good reason for discarding it. It has, however, some disadvantages in sailing qualities which detract from its value; it sails very fast with the wind on either quarter, but cannot run before the wind, or sail close to it. It has bulkheads (which the Chinese have used for years unknown) and many of them come into harbors after gales with the bows completely destroyed by heavy seas, but with their cargoes intact. They are usually handled by one man and his family, the wife steering with the aid of a small boy to help run the tiller over, and, clumsy as the junk appears, they are easily navigated by this "short-handed crew." The rudders have large diamond-shaped apertures in them which facilitate putting them over, and do not detract from their efficiency. The sails are usually of cotton, sometimes of reed matting, and are so knocked about that they are badly torn, but there is always area enough left to handle the vessel.

In building vessels the Chinese follow the rule of thumb, or the plans of procedure handed down to them from ages past; they are

capable of building modern ships from wood, but do not read drawings well, still less are they able to calculate from them, and all this without assistance from Europeans. Most of the vessels are of wood, imported from the Philippine Islands, for China is a treeless country, and the native workmen understand the handling of these woods better than any other people in the world.

There are plenty of workshops in China where there is not a single European employed, and the author of the paper says they are very docile, learning readily the methods pointed out to them, with no predilections for trade unions. There are some very able draughtsmen to be found among them, and but rarely, mathematicians. The ship owners themselves are said to be very easily satisfied and pay no attention to the construction of their vessels, their supervision being wholly confined to seeing that they get the scantlings they pay for.

It is a mistake, says the author of the paper, to assume that the Chinese are so conservative they will not adopt new ideas; they are very ready to do so after the utility of them has been proved by someone else. They are not experimenters, but discover things by accident or evolution, and, so far as the laws of the country permit, will use any process or machine that has been demonstrated to be of practical value.

### Red Dust Analysis.

Mr. Barac, in the Journal of the Meteorological Society, gives an analysis of a sample of the dust which he collected at Fiume (Hungary) on the 10th of March during the red dust-shower known as the "rain of blood." The dust analyzed as follows:

| | Per cent. |
|---|---|
| Silica | 49.89 |
| Sesquioxide of iron | 9.96 |
| Alumina | 12.10 |
| Peroxide of manganese | 1.99 |
| Lime | 11.46 |
| Magnesia | 0.40 |
| Carbonic acid | 8.96 |
| Organic matter | 5.48 |

Also traces of soda, sulphuric and hydrochloric acids, etc. With a microscope of 640 diameters M. Barac found that the principal mass was colorless, with colored particles of irregular form partly made up of angular fragments of crystals, also mineral particles and silicious skeletons of micro-organisms, and lastly particles of soot. A further examination showed the existence of well-formed rhombohedra of calcite and cubes of common salt. As regards size, the crystalline particles varied from a minimum of 0.00004 inch to 0.00007 inch mean and 0.002 maximum, while the yellow and structureless particles reached 0.00046 inch.

### THE EVOLUTION OF THE MOTOR CYCLE.

BY HROLF WISBY.

Only a few years ago it would have been impossible to secure an efficient, safe, and practical motor cycle. It is only within the last two years that this special industry has shed its experimental swaddling clothes. It is now at a stage when the standardizing of essential features, the interchangeability of parts, and the comparative unanimity of design has put it on a practical mechanical and commercial basis.

France led the way. She was the first to produce a practical motor tricycle. In England, where the three-wheeler has always been popular, the makers were quick to follow suit. In this country three notable bicycle manufacturers produced mechanically successful patterns of motor tricycles, which, however, failed to attract the public, doubtless for the reason that the three-wheeler has never been a favorite here. The motor bicycle, however, supplies the hitherto "missing link" between the bicycle and the automobile, between the poor and the rich of the speeding sport. It makes its owner feel that he is still a wheelman in spite of the snorting motor on his wheel, and when automobiles of much larger horse power try to pass him in vain on the road he is pleasantly reminded that he is in it and able to hold his own among the swift company of the automobilists. That, too, has something to do with the popularity of the motor bicycle. It is far cheaper to operate than the smallest launch, it is much less liable to get out of order than the most reliable type of horseless vehicle, and it is the swiftest and most economic vehicle known in proportion to weight, carrying capacity and fuel consumption.

#### A SIMPLE COMPARISON.

A motor bicycle weighing only sixty pounds, of 1½ horse power, will easily and safely carry a man weighing 180 pounds across the average kind of country road at a maintained speed of from twenty to twenty-five miles an hour. The automobile has not been built which, weight for weight and proportionate power, could come anywhere near this performance. When it is considered that the factor of safety in steel bridges is four, or, in other words, that a bridge to be safe must be strong enough to sustain four times the sum of its own weight and the live load, the fact that the motor cycle is able to carry three times its own weight and over, in addition to propelling this load at a rate of speed prohibited on most bridges, and by virtue of a comparatively small horse power, we begin to appreciate the amount of practical science involved in the building of the motor cycle.

#### SOME SPECIAL DEVELOPMENTS.

When the English Singer motor tricycle was first introduced, it was ridiculed as a toy of very little practical use. Wheelmen jeered at the idea of comprising the motive power within the front steering wheel, and automobilists—don't ride motor cycles. It was soon found, however, that this unsightly but reliable machine would carry its passenger over British roads at a twenty-mile clip with no material drawback except the liability of the steering wheel to be jerked from side to side in traversing rough pieces of road.

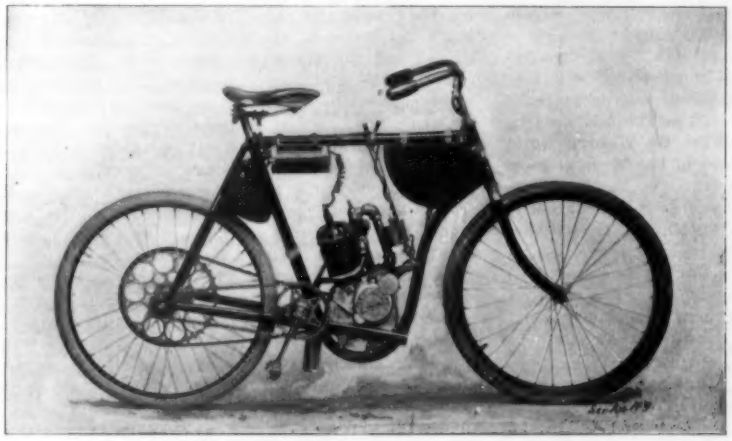
Another quite characteristic, but not so very reliable development, is evident in the English Derby motor bicycle, which transmits power directly to the rear-wheel tire by means of a spur-gear contact arrangement.

Among other interesting foreign types may be mentioned the Werner, which has a belt-driving motor attached on the steering head and outside the frame; the Minerva, of practically the same construction, with a belt-driving motor on the bottom frame tube flush with the crank-hanger; and the Rex, chiefly remarkable for an aluminium bed fixed on the bottom frame tube, to which the motor is bolted.

#### SUPERIOR DEVELOPMENTS.

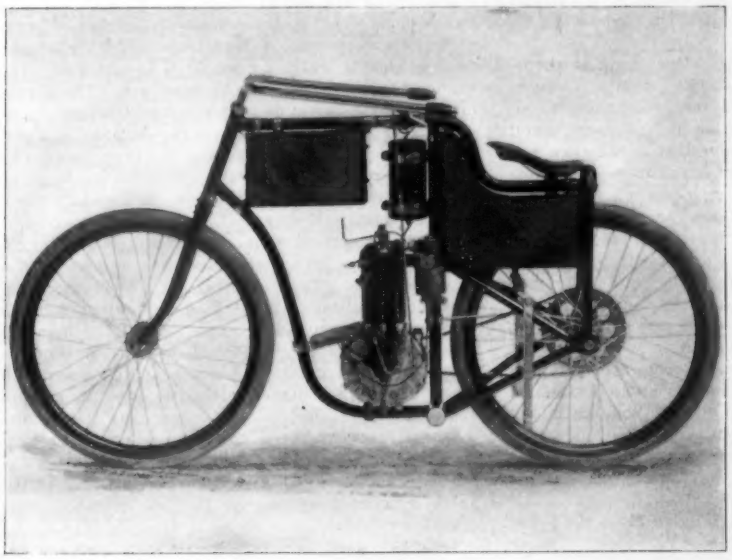
If we will regard these various phases of motor cycle construction as forerunners of the distinctly superior developments as evidenced in the 1902 models of the leading American makes, we shall be in a position to better appreciate the advance made by our makers.

It is difficult to say which is most popular in this country, the chain or the belt-driving motor cycle, though present indications point to the obvious desirability of the belt driver. A round rawhide belt insures a smooth and much less jerky pull than a chain. It is considerably cleaner, not quite so liable to break, and permits of almost instant adjustability. With a



The Patee Motor Bicycle (1½ H. P.)

The Mitchell Motor Bicycle (2 H. P.) with Flexible Rawhide Belt.



The Stearns Racer (3¾ H. P.)

A French Motor Tandem for Pacing. (Combination Gasoline Tank and Wind Shields.)

belt drive it is an easy matter to change motor pulleys from, say 4 inches for hard road work, to a 5-inch or 7-inch size when the roads are fine, or for speeding on the track.

Although the several patterns of American chain-driven motor cycles differ ostensibly in model, and rationally in various constructive details, they may, on the whole, with propriety be classed together as belonging to the frame-contained motor chain driver, that is, the motor is invariably placed within, and never without, the frame. The Stearns, the 1902 racing model of which is herewith shown, is a type of the chain driver. This odd-looking machine was designed especially for speed to replace the motor tandem in furnishing pace to the racing men. The rear wheel is very wide, the hub measuring 11 inches in width. This arrangement serves to shield the rider following the machine against any undue wind pressure. In order to get the saddle down as low as possible, to further screen the rider, it is clamped directly to the upper frame tubing. The operator sits directly over the rear wheel, in easy reach of the motor, managing the steering by means of a brace of huge, elongated handle bars. The absence of pedals on this machine is explained by the fact that they are entirely superfluous for racing. The operator does not in any way aid the progress of the machine. There are two foot rests or stirrups into which he is supposed to put his feet. A De Dion 3¾ horse power motor furnishes ample power to send this machine around the track at more than fifty miles an hour. The motor is of the high-speed pattern, making from 600 to 2,000 revolutions a minute, and the gear is 132 inches. The weight of this machine, which was recently built to pace Jimmy Michael, is 165 pounds.

Among belt-driving motor bicycles, the Mitchell is undoubtedly the most characteristically American model, being in simplicity of design, ease of handling, and efficiency of power decidedly superior to any foreign machine, and unexcelled by any domestic make. I am speaking particularly with reference to the 1902 Mitchell model, the beautiful lines of which are herewith illustrated. The motor has a 3x3 inch cylinder, makes 1,800 revolutions per minute, developing an actual brake test power of 2 horse power, or, in other words, 3 to 3½ horse power as motors are usually rated. This power is sufficient to propel the machine at speeds varying from five to thirty-five miles in the hour. The frame is made of heavy-gage seamless steel tubing, and being only twenty-four inches high is exceedingly convenient. The hanger is dropped 2½ inches, and the wheel base is only 45 inches, making a very compact and strong design with no suggestion of clumsiness. In order to more perfectly balance the load and secure a long belt pull, the motor has been placed within the frame head directly under the rider's control, which position at the same time precludes the possibility of "skidding"—a not uncommon feature with machines having low-mounted motors.

The fuel feed is extremely simple and easy to manipulate. It is of the so-called "drip feed" system, which does away with the troublesome carbureting devices so common on foreign-built machines. Instead of the ordinary surface carbureter, a feed pipe is led direct from the gasoline tank into a small vaporizer. The quantity of fuel administered in this way is regulated by means of a small thumbscrew with a pointer on an index dial indicating the amount of gasoline fed to the vaporizer. The air inlet is fixed, the volume of air taken into the vaporizer being gaged by the working piston. Instead of the usual throttle valve between the carbureter and the engine, a drip feed of gasoline is introduced through the vaporizer into the engine by the suction stroke. There could be no more direct and simple form of liquid fuel feed. After filling the fuel tank with ordinary gasoline, and the lubricating tank with engine oil, the operation of the motor is effected by opening the valves of these respective tanks, besides the compression cock. The machine may now be mounted. After a few revolutions of the pedals, simultaneous with turning the left grip, which serves as a switch, to the right, three or four sharp explosions are sure to follow, whereupon the compression cock should be closed, and the motor will now carry the machine along at a slow, steady pace. Speed is increased by moving the handle of the "sparker" forward; speed is decreased by moving the handle backward; to slow down temporarily the switch may be turned off, and to stop the machine altogether the current is shut off by turning the left grip toward the left and at the same time applying the coaster brake by pressure on the pedals. On coming to a stop the sparking plug is taken out, the gasoline and the lubricating oil valves are turned off, and the compression cock is opened. These movements are exceedingly simple and elementary, and after practising the rudiments of operation a few times any ordinary wheelman will find himself in reassuring control of the machine. Among the improvements in the 1902 Mitchell is a ball bearing idler, a speed device placed conveniently for manipulation, and a valve lifter. The mixer used in connection with the motor has the merit of not being affected by travel over rough roads, like the ordinary kind of carbureters. This machine, while not a racer, is powerful enough for all touring purposes. The efficiency of the motor enables the operator to climb almost any hill, plowing through sand, and going against head winds at a fair rate of speed, while on good roads upward of thirty-five miles an hour may be negotiated. Fully equipped for touring, with 1¾-inch five-ply tires, the machine weighs 110 pounds. The tank capacity of the reservoir is seven pints, which is ample fuel for a distance of 65 to 75 miles.

The motor cycle industry may as yet be in its infancy, but it is, nevertheless, capable of producing machines like the above which are daily demonstrating a high degree of efficiency and reliability in practical work on the road.

### International Geographical Congress.

Baron von Richthofen, the famous professor of geography in the University of Berlin, has just informed President Alexander Graham Bell, of the National Geographic Society of Washington, that the Executive Committee of the Seventh International Geographical Congress, which was authorized to make arrangements for holding the next meeting, has accepted the invitation of the Washington society to meet under its auspices at our national capital. The Congress will not be held till 1904 and there will therefore be plenty of time in which to arrange a programme of great interest and value. It will be the first meeting of the International Congress in the Western world and undoubtedly a large number of the foremost geographers of Europe will be present.

The society under whose auspices each congress is held has charge of the arrangements. The National Geographic Society, accordingly, will have nearly everything to do with the selecting of topics that will be most prominent in the deliberations of the congress. It will select men who are authorities in their special lines of geographic study to read papers and lead in the discussions.

Before the congress meets, the large and handsome home of the National Geographical Society will have been completed in Washington. The building is named in honor of the late Gardiner G. Hubbard, the founder and first president of the society, who lived to see many hundreds of persons, interested in geographic science in all parts of the country, enrolled among the members.

Baron von Richthofen, in his letter accepting the invitation of the Washington society, says: "There is, indeed, no place better fitted for geographers to assemble than Washington, which is the great center of scientific geographical exploration in America and the distinguished workshop of a considerable number of eminent men."

A conspicuous feature of these congresses has been a geographical exhibition containing a great variety of objects illustrating the world's progress in topographic and geodetic surveying, map, globe and relief-map making, the production of text books and other school appliances and so on. This feature was omitted in the last congress, held in Berlin, but it will be an important additional attraction if such an exhibition is held in connection with the Washington meeting. It would certainly be helpful to the geographical interest of this country if such a collection should be formed in Washington and permanently maintained there under the auspices of the National Geographic Society.

The society has had the assurance from the other geographical societies of the country of their hearty co-operation in making the meeting of the congress a success. The geographers of Washington express the hope that it may be found practicable to hold sessions of the congress in a few other cities in conjunction with their geographical societies. Such a meeting should certainly be held, if possible, in this city, where the American Geographical Society is about to open its new building on West Eighty-first Street. The edifice which this society has just completed is believed to be the most commodious and attractive structure occupied by any geographical society. It is a fitting home for the fine library which represents a half century of book collecting; and it offers facilities for reading and work that were not available in the smaller house so long occupied on West Twenty-ninth Street. Boston is the home of the Appalachian Club, Philadelphia of the Philadelphia Geographical Society, and Chicago, San Francisco and Seattle also have their geographical societies.

Excursions are always a prominent feature of these congresses. The Washington society expects to offer its guests an attractive series of excursions to points of geographic interest. Washington is centrally situated in respect of natural features that appeal to geographic students. Niagara Falls, the Natural Bridge of Virginia, Luray and Mammoth Caves are within easy reach. It is probable that one of the excursions will be to the Pacific Coast.

The preparation for one of these international congresses involves an enormous amount of labor, but since the first congress was held in Antwerp in 1869 they have been found to be worth all they cost in the geographic results attained and the opportunities they have afforded for social intercourse among the foremost workers in this field of knowledge. The National Geographic Society will certainly spare no effort to make the coming congress a success; we may look for a very large convocation of geographers here in 1904, says the New York Sun.

### HYPNOSIS IN FROGS.

Hypnosis in animals is a question that has been very little studied. At the Fifth International Congress of Physiology, which recently met at Turin, Mlle. M. Stefanowska, of Brussels, read a very interesting paper upon this subject entitled "The Conditions Favorable and Unfavorable to Hypnosis in Frogs," and of which the following is a brief abstract.

Frogs that have remained in an aquarium during the winter afford excellent subjects for the study of hypnosis, at the moment when they are thoroughly exhausted by a prolonged fast, that is to say, in spring and early summer. As soon as they are turned upon their backs they fall into a hypnotic state which often reaches that of catalepsy. In a state of profound hypnosis, the action of the organs of the senses is suspended and the kinesthesic sense is greatly blunted, as is also the sensitiveness to pain. The pupils are always contracted, but dilate as soon as the animal awakens. The cardiac motions slacken and the respiratory ones are often scarcely perceptible. Such a state may persist for half an hour or more.

Profound hypnosis is still more marked in winter frogs when their body has lost much water in consequence of a stay in a dry place. Such frogs cannot always be awakened at the moment desired.

Frogs captured in spring undergo hypnosis under the same circumstances, but are more resistant. They become more and more hypnotizable in measure as their fast is more prolonged. This fact accords with the observation of Gley that hypnosis is easily produced in frogs that have grown lean. According to Mlle. Stefanowska, exhaustion, a prolonged fast and the loss of water appear to be the conditions favorable to the production of hypnosis and catalepsy in adult frogs. Let us remark further that, according to the researches of this author, frogs in a state of profound and prolonged hypnosis immediately awaken as soon as they are surrounded with the vapors of ether, chloroform or alcohol, which act primarily as excitants. The vapor of ammonia acts in the same way. The abrupt or progressive elevation of temperature always interrupts the state of hypnosis. On the contrary, a lowering of the temperature does not awaken frogs, and even appears to be favorable to hypnosis. The three accompanying figures show a few characteristic attitudes of frogs in the hypnotic state. Upon looking at them we cannot prevent ourselves from thinking of the attitudes of hysterical persons plunged into a hypnotic sleep. The frogs present nearly the same spasmodic positions as do those hypnotized subjects christened so picturesquely by Féré as "laboratory frogs." The difference resides in the suppleness of the attitudes, which are purely muscular and general in frogs, but more delicate and at the same time more expressive in hysterics. It is true that the animal scale embraces many types of vertebrate from the nervous frog, which also has its hysterical individuals (as De Tarchanoff has recently demonstrated), up to the noble hysteric belonging to the last round of bio-organic evolution.

We dwell upon the researches of Mlle. Stefanowska, aside from the importance of the question in itself, because we too have made some experiments upon hypnosis in frogs and especially upon the species known as *Rana temporaria*. We shall here sketch the principal facts of such researches in a brief manner, it being our intention to return to the subject in a general work on hypnosis in animals. In fact, we have experimented, and are continuing to experiment, upon dogs, cats, guinea pigs, rabbits, chickens and snakes. To our knowledge, no work has been undertaken upon so numerous varieties of animals. At present, we shall occupy ourselves with hypnosis in frogs solely.

Gley makes a correct observation in remarking that hypnosis is particularly favorable in half-starved frogs. The fact is true, and our observations agree with those of Mlle. Stefanowska. Our frogs, emaciated or fasting, were easily hypnotized, and a goodly number of them entered into a cataleptic state. Their sensitiveness was almost abolished, their pupils punctiform, and their circulation slow; and their respiration became so much the more superficial in proportion as the hypnosis became more profound, and that, too, with a crisis of internal respiration corresponding to a marked acceleration of the heart. What is new in our experiments is the hypnotizing of frogs by looking them in the eye, and aside from any fasting. We made the experiment in summer, taking care to feed the animals in an aquarium in which they were living immersed in water.

The frogs were therefore in the best of conditions of vitality and in a state sensibly near that of their normal life.

In one series of experiments, we tried to hypnotize the frog by holding it in the hands and turned upon its back. It is extremely difficult to get the gaze of the frog. The color of the skin and eyes and the absence of expression in the look render the fixation of the latter difficult. It is necessary to perform the experiment as far as possible under conditions of uniform light. We experimented with both daylight and artificial light. This often constitutes a source of error in acting as an element of fatigue. Some precautions have to be taken by the experimenter for holding the frog in the hands. It gesticulates, as it were, its heart beats rapidly and its body easily slips between the fingers, and these are so many coefficients that have an influence upon the success of the experiments. The frogs go to sleep quite easily after some resistance. We have had frogs in our hands that we could not put to sleep until the end of an hour, and others that we could put into merely a slight slumber. The gaze, therefore, acted, as in human subjects, outside of any special experimental condition.

In a second series of researches we tried to produce sleep in frogs in a state of liberty, and that, too, under two different conditions. The frog was placed upon the laboratory table or was swimming in a sufficiently deep glass vessel in which we could observe it at our ease. The hypnosis then became more difficult, that is to say, it took a longer time to effect it. As is well known, frogs in a state of rest have an attitude quite well adapted for hypnosis. They look upwards and the head reminds one of an attitude of ecstasy or admiration. I have succeeded experimentally in putting them to sleep upon the spot and in piercing their skin with a needle or hot iron without their manifesting the least reaction. The hypnosis, although profound, does not last long. It is short, in fact, and the animal often awakens, making an abrupt leap.

Hypnosis is likewise possible when the animals are swimming in a glass crystallizing pan, but it requires time and a dexterity that experiment alone can give. It is quite a characteristic fact that, although able to hypnotize frogs, we never could succeed in making them jump into the water. The hypnosis was not profound, although the sensitiveness became obtuse; it seemed as if the animal was automatically master of its kinesthesic attitude. The changes of position were delicate, although possible, and were incapable of extending to changes of the whole body. What characterized the profoundest state of hypnosis that we were able to obtain was a slight plunge into the water with a few "cat-naps," generally followed by an awakening. If the water was slightly heated, the hypnosis was interrupted; but Mlle. Stefanowska has, on the contrary, observed this fact in other states. When the temperature lowered progressively it appeared as if the frogs ceased, in a certain measure, to be master of their position in the water.

These facts, similar to those observed by Mlle. Stefanowska, but of the complete details of which we are ignorant, and especially to those observed by Gley, speak peremptorily in favor of the possibility of hypnosis in frogs, and demonstrate once more the anæsthetic power, so to speak, of the human gaze, that complex factor which seems to synthetize our whole dynamic cerebrality when it is in action. It must be concluded, then, that such gaze acts not only upon man, but upon frogs. There are here some important psycho-physiological approximations that make us reflect upon the nature of that mysterious force which slips through the windows of our psycho-organic life and acts as a true anæsthetic in fixing the attitude of animals like those of man and paralyzing all cerebral life.—This description was written by N. Vaschide, in La Nature.

DIFFERENT ATTITUDES OF HYPNOTIZED FROGS.

H.M. Consul-General reports that it has recently been stated that the German government has contributed a certain sum toward the costs of experiments which are being made in Germany for providing fishing (sailing) vessels with auxiliary screw propellers worked by petroleum as motive power. Such an arrangement would, it is thought, be of great advantage, for the fishing vessels would thus be able to fish during complete calm, and, while earning more in this way, would also be able to convey their catch more quickly than at present to market.

## A RARE FISH.

BY C. F. HOLDER.

From a zoological point of view the island of Santa Catalina, which lies eighteen miles off the coast of Los Angeles County, Southern California, is very interesting, many rare animals being found there. Every winter the dwellers of the island find numbers of Argonaut shells and several living specimens have been secured, one for a time living in the aquarium which is maintained here for the benefit of students and the entertainment of visitors. A number of rare and interesting fishes wander inshore from time to time. Several years ago I found various Scopeloid fishes, which up to that time had been considered rare, and during the past few years I have seen one oarfish (*Regalecus russelli*) alive, while another was brought to me dead. From reports I judge that a number of these very rare fishes have been observed here. The first was of small size, not over two feet in length, and was discovered swimming in shallow water along the beach of Avalon Bay. I had an opportunity to observe the radiant creature before it died. Its "topknot"—it can be compared to nothing else—was a vivid red or scarlet mass of seeming plumes—the dorsal fins, which merged into a long dorsal fin, extending to the tail. The color of the body was a brilliant silver sheen splashed with equally vivid black zebra-like stripes, which gave the fish a most striking appearance.

The fish was a fragile and delicate creature, a very ghost of a fish, which swam along where the water gently lapped the sands, with an undulatory motion, looking like one of its names—the ribbon fish. The fortunate finder of this specimen could not be persuaded to give it up or sell it, and it was its fate to be pasted upon a piece of board, dried in the sun as a "curio," where, as if in retaliation at the desecration of so rare a specimen, it soon disappeared.

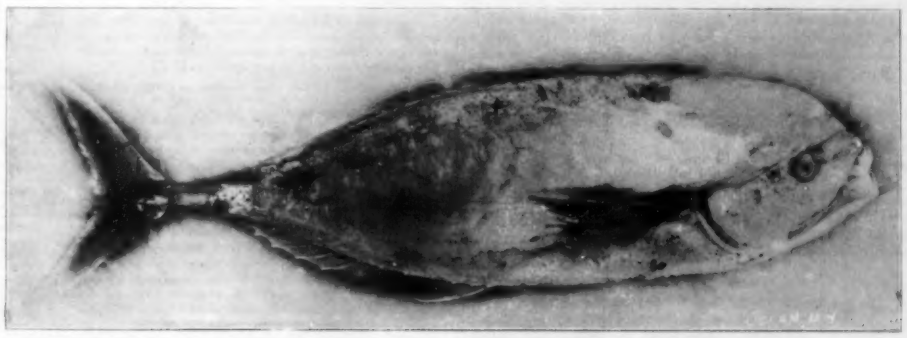
This apparently was the first oarfish ever seen in the United States, so at least Dr. G. Brown Goode wrote me at the time that it had not been reported. In 1899 another oarfish was brought to me, evidently having been washed in after a storm and found within a few yards of the former at Avalon. The discoverer of this specimen also refused to allow it to be properly preserved, or to donate or sell it to any one who would have sent it to some museum, but, believing it valuable as a curio, also impaled it, the delicate creature evaporating under the strong heat of the semitropic sun.

This, as stated, was the second fish discovered, and during the past winter (1900) a fine large specimen came in at Newport Beach, being reported by H. J. Forgy, of Santa Ana. The newspapers announced that a Mexican had found a young sea serpent at Newport, and investigation showed that, as in hundreds of similar instances, the man had found a valuable prize without being aware of it. According to the account, the discoverer first saw the fish alive in the surf and hauled it ashore. Being ignorant of its value he cut it up, bringing in a part of the scarlet fins and a slice of the flesh. This he showed to some men, and led the way to where lay the mutilated remains of one of the finest oar or ribbon fishes ever seen. The specimen was twenty-one feet in length, and its weight estimated at five hundred pounds. The finder had so mutilated it that the fish was ruined for almost any purpose. If he had packed it in salt the specimen would have returned him the equivalent of several months' labor. Apparently the man had cut it up in wanton amusement.

This recalls a similar incident. I was on one occasion excavating at San Clemente Island, and had remarked that it was a singular fact that all the fine stone ollas were broken. "Nothing strange about that," said a half-breed, one of the party. "I used to herd sheep here, and we smashed mortars and ollas to pass away time."

One of the most interesting visitors to Catalina came ashore at what is called the Isthmus. It was somewhat mutilated, as shown in the accompanying illustration, and was entirely new to the fishermen, some of whom were Venetians. The fish was evidently allied to the mackerels, and when found displayed evidences of great beauty of coloring, at its best undoubtedly being an active and beautiful fish. In response to a photograph sent to Dr. C. W. Gilbert, of Stanford University, he wrote; "It was not until recently that I have had opportunity to examine carefully the photograph, which obviously represented no species known to the Californian coast. I find now that it represents an undoubted specimen of a form hitherto known only from the Mediterranean and neighboring waters—*Luvarus imperialis*. It is said to be rare in its home waters, and is yet unreported from our Atlantic coast."

This wanderer was injured in some way, possibly cast up by a winter storm. According to Goode and Bean, "Oceanic Ichthyology," the type specimen was about two feet long, observed by Rafinesque at Solanto, Sicily, June 15, 1808. It is a rare fish, but has been seen at Nice, at Malta, Elba and at Cette, and a fine specimen can be seen in the Museo Civico at Genoa; but so far as known none of the American or any of the other museums of Europe have specimens. The fish has been observed at Madeira, both old and young, according to the same authorities, and Steindachner reported it from the coast of Spain. In 1866 a small specimen came ashore on the Cornish coast, and from this Day made the figure to be found in "Fishes of Great Britain and Ireland." Giglioli has pointed out the interesting series of metamorphoses by which *Astrodermus* and *Diana* develop into *Ausonia* and *Luvarus*. But one species and a single genus are known.



A VERY RARE FISH—LUVARUS IMPERIALIS.

The first specimen ever seen in America, found at Santa Catalina, Cal.

### The Current Supplement.

The front page article of the current SUPPLEMENT, No. 1355, describes both verbally and graphically the progress of the work on the Simplon Tunnel, one of the most stupendous engineering works of our time. Another engineering article, both timely and interesting, is a comparison between the proposed Nicaragua and Panama canals, in which the former is shown to be distinctly inferior to the latter. A simple form of differential gear for bicycles in use in France is described and illustrated. Rear-Admiral George W. Melville's address at the unveiling of the monument to Robert Fulton, erected in New York, is published in full. "The Economic Position of Japan" chronicles the progress made by the most enterprising of Eastern peoples during the short period of its modern commercial existence. The director of the Blue Hill Meteorological Observatory, A. Lawrence Rotch, discourses instructively on the use of kites in obtaining meteorological observations, supplementing his written work by illustrations of rare value. Among the technological articles will be found a treatise on the "Enameline Process—Etching on Zinc," which contains information that, probably, cannot be obtained in any of the books on process engraving. Something new about Carthage, a city whose historical interest is rivaled only by that of Rome, is told in a fully illustrated article bearing the title "The True Carthage." A concise and thorough résumé of "Batrachia and Reptilia" will prove of interest to our zoological readers.

## RECENTLY PATENTED INVENTIONS.

### Mechanical Devices.

MECHANICAL TOY.—CHARLES H. SCHOLL, Reading, Pa. The toy is a car propelled partly by gravity and partly by a motor along a continuous track having various inclines. The toy will be found very amusing, especially to children, since the cars are sufficiently large to hold dolls and the like.

BOLT.—JOHN SPEIRS, Jersey City, N. J. The bolt can be applied to a door, either right or left, and acts to lock and automatically to prevent the door from being opened beyond a certain distance until purposely unlatched from the inside. The bolt is simple and strong and can be attached to the moldings or door-jambs.

MECHANICAL GEARING.—LEONARD S. FLECKENSTEIN, Easton, Md. The inventor has devised an effective substitute for cog, friction or belt gearing for operating machinery, in which some parts have a continuous and others have an intermittent rotation. Combined with two parallel end shafts and two pairs of sprocket-wheels thereon are an intermediate shaft and two loosely-mounted sprocket-wheels. A sprocket-wheel is keyed on the intermediate shaft and is arranged between the loose wheels. A double or two-part chain runs over all the sprocket-wheels except the keyed wheel of the intermediate shaft. By this construction of sprocket chain and sprocket-wheels continuous and intermittent rotation of shafting is obtained in the most economical manner.

WINDOW-SHADE MACHINE.—FRANK L. FISHER, Cumberland, Md. By means of the novel construction forming the subject of this invention the shade can be trimmed off on its side edges to any desired width and can be cut off at any length. The ends are creased so as to form a guide for folding over the strip to bar at the free end of the curtain. The hem can therefore be produced regularly and uniformly as desired.

### Railway Contrivances.

SEAL-LOCK.—HENRY A. RODERMUND, Montague, Cal. This lock and seal for railway-car doors is so arranged that the seal is impressed or formed on a blank during the operation of closing the car-door. Upon unlocking and opening the door the seal will fall into a receptacle and be saved for future melting and use, thus resulting in a saving of lead usually thrown away or lost.

SWITCH-SIGNAL.—BERTIS H. URSCHEL and EDMUND P. THOMAS, Sugar Bridge, O. The contrivance relates to signals for single-track electric roads, such as are used in country districts and in which turnout switches are placed at suitable distances apart. The object is to provide a signal mechanism to be operated by a moving car in such a manner as to leave a signal light at one switch and at the same time turn on a light at the next switch ahead, and upon passing the latter switch to turn out both former lamps and turn on another lamp at the second switch and one at the next or third switch. This turning on and off of lamps is effected throughout the length of the line, thus preventing possible collisions, between switches, of cars moving in a same or opposite directions.

SAFETY APPLIANCE FOR TRAINS.—JACINTO V. VELASCO, Key West, Fla. Mr. Velasco has invented a new safety appliance for trains to prevent a train from running off a track, especially when rounding turns or traversing switches. The appliance comprises a central-track guideway in which a shoe is arranged to travel. A support is mounted to slide vertically in a bearing on the car truck, the shoe being mounted to turn at the lower end of the support. The shoe cannot leave its guideway at the crossing.

CAR.—BENJAMIN BULKLELEY, Marion, Iowa. The car is of the hopper bottom type. A new bottom-door is provided more especially designed for ballast-cars carrying crushed stone or other material. The door can be easily opened to drop the contents of the car in separate piles in the road-bed. The arrangement permits the quick closing of the door to stop the discharge of the material whenever desirable.

### Building Appliances.

FLUSH-BOLT.—HENRY G. KARRENBERG, Manhattan, New York city. The flush-bolt is of such construction that it can be effectually locked in an open or closed position. The bolt cannot be moved from either position without opening a key-operated lid forming a part of the bolt-casing. Should the lid be unlocked the operating medium of the bolt will be protected and concealed while the lid remains closed.

CORNER-POST AND JOINT.—JAMES E. and CHAUNCEY B. BROWN, Bradford, Pa. The corner-post forms an improved joint for use in carpentry, furniture, vehicle bodies, and the like. The corner-post is provided with dovetail tongues having angular, integral feathers. The tongues and feathers extend in the longitudinal direction of the post. A number of panels engage the post, the panels having grooves to receive the tongues and feathers. The inventors state that the only way to separate the post from either of the panels is to tear asunder the parts. Mere chipping off of a small portion of wood will not effect a severance.

LINTEL.—WILLIAM F. PELTON, 1125 Broadway, Manhattan, New York city. "The Pelton patent steel tension lintel" will probably receive the approval of every architect and builder; for the old-fashioned cast-iron structure is discarded. The upper member of the lintel is a compression member, the bottom member a tension member, each good for 16,000 pounds per square inch sectional area, giving a factor of safety of 1 to 5. The end skewbacks take up the strain on the arch. The invention is noticeable for the fact that it applies well-recognized engineering principles.

FOLDING BRACE.—LEWIS B. JEFFCOTT, Manhattan, New York city. The folding brace is to be used for the support of shelves and the like. It is arranged readily to lock itself in an extended position when the thing supported is swung into an active position, and automatically to unlock itself and fold up by the operator's swinging the article a little farther up and then releasing it to allow the brace to fold and the article to swing into a folded position.

### Horseshoes.

HORSESHOE-PAD.—DANIEL W. MALONEY and JAMES H. WELSH, White Plains, N. Y. A rubber pad and a shoe are so combined that the shoe practically becomes a portion of the pad. The inner face of the pad conforms with the bottom of the hoof, affording an equal bearing to the foot and preventing the pad from shifting and dirt from collecting under the pad and shoe. At the heel portion on the upper face of the pad are transverse ribs arranged to enter the frog and the spaces between the side walls of the hoof and the frog. The ribs serve to brace the pad and prevent its shifting.

HORSESHOE.—JOHN L. F. C. KOBER, Cincinnati, O. The horseshoe is provided with removable calks, by which construction the calks can be repaired frequently without necessitating the removal of the shoe from the horse's hoof.

### Miscellaneous Inventions.

WRENCH.—HENRY T. NEFF, 512 North 12th Street, St. Joseph, Mo. The fixed jaw is widened so as to project beyond the opposite sides of the handle and to provide ways alongside the handle for the arms of the sliding jaw. Projecting from the rear side of the sliding jaw are parallel side arms which fit within the ways provided above the fixture and alongside the shank, the free extremities being widened to project above the handle shank. A bar connects the arms at their free ends and extends beneath the handle-shank. A pawl is supported between the widened ends of the jaw-arms and engages a ratchet on the handle-shank. Over the handle-shank and the arms of the sliding jaw a cuff fits which is secured to the fixed jaw.

CHURN.—ELI R. DEMING, Detroit, Mich. Air is constantly supplied to the cream during the churning, the dash-stem and dash-blades serving as conducting mediums for the air. Any economic form of driving mechanism is employed. The internal operative portions of the churn are of such construction that they can be readily disconnected from the body and the driving mechanism, rendering it possible to clean each part of the churn which is brought in contact with the cream.

HOLDER FOR CUPS OR PLATES.—ELEONORE K. HALLENBERG, 3 Alford Building, Louisville, Ky. The invention provides an improved holder for cups, plates, or pictures and is particularly adapted for suspension from a shelf and to assume a position in which the cup and plates are projected forward so that they are exhibited to the best advantage. The invention further includes a movable device to engage plates or pictures of different diameters and to serve as a support for cups that are to be exhibited with plates. The holder is made with a tripod, one of the legs being hinged so as to fold or lie between the others when required for use.

WIRE FENCE.—ERNEST L. EWBANK, Hendersonville, N. C. The posts used are made of metal with dovetailed notches along the edges. The wires are located in the notches and are held in place by flat wedges corresponding in shape with the notches. On its inner face each wedge has a longitudinal groove to form a wire-seat. The wedges are to be manufactured by number after the manner of ordinary nails. Wedges having a groove larger than the circumference of the wire used can be placed in alternate posts in order to permit the wires to yield if a weight, such as a tree, should fall on the fence, and in order to permit the wire to return to its position after the weight has been removed.

CLIP.—THOMAS K. DAVISON, St. Albans, W. Va. The clip is especially useful for holding curtains and portières. The construction of the device is such that it can be effectively used without in any way injuring the fabric, however delicate it may be.

FIRE-ESCAPE.—HENRY O. CEASE, Louisa, Ky. A novel construction of car, together with guiding, supporting and operating devices therefor, is provided, whereby the car can be readily raised to any suitable height and can be lowered under the control of the occupants of the car or of persons on the ground.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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"U. S." Metal Polish. Indianapolis. Samples free.

**Inquiry No. 1760.**—For dealers in jewelers' findings.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

**Inquiry No. 1761.**—For manufacturers of electric motor models.

Stencil Machines.—A. J. Bradley, 101 Beekman St. N.Y.

**Inquiry No. 1762.**—For a machine for taking up the lost motion on buggy axles, etc., cutting off the point and rethreading as it cuts.

Gasoline Lamps and Systems. Turner Brass Works, Chicago.

**Inquiry No. 1763.**—For firms in Illinois in the re-rolling rail business.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

**Inquiry No. 1764.**—For manufacturers of compressed air carpet-cleaning machinery.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

**Inquiry No. 1765.**—For manufacturers of imitation leather.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

**Inquiry No. 1766.**—For dealers in belting of various kinds.

Sheet metal, any kind, cut, formed, any shape. Prompt work. Metal Stamping Co. Niagara Falls, N. Y.

**Inquiry No. 1767.**—For machinery for the manufacture of wood alcoho .

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

**Inquiry No. 1768.**—For a good patent for steel baskets.

CANS.—¼ pint and ½ pint tin cans are manufactured by National Cement Co., Toledo, O. Write for prices.

**Inquiry No. 1769.**—For a 6-inch oil separator and contrivance for condensing exhaust steam by cooling with mine water, or otherwise.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

**Inquiry No. 1770.**—For an evaporator and condenser to convert mine water to boiler use.

Manufacturers of patent articles, dies, stamping, tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

**Inquiry No. 1771.**—For a separator for preventing the passing of dirt through a 6-inch steam pipe.

Constructor and operator of wood chemical plants, including refineries and by-product apparatus. O. A. Myers, 625 West Fourth Street, Cincinnati, Ohio.

**Inquiry No. 1772.**—For manufacturers of acetylene lamps.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

**Inquiry No. 1773.**—For an ice manufacturing plant with a capacity of 25 tons per day.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

**Inquiry No. 1774.**—For manufacturers of a hydraulic wheel for rivers with a slow current to produce sufficient force to operate a pump giving 8 to 6 gallons of water per minute.

FOR SALE AT A BARGAIN.—100 tons 66 lb. steel girder relaying rails, 30 feet lengths. Wheelock twin high-pressure engines, 24 x 48 cylinders, A1 condition. M. Braudy & Sons, Grand Rapids, Mich.

**Inquiry No. 1775.**—For a centrifugal extractor of gold ores.

WANTED.—Experienced draughtsman on mill machinery and machine tools. Permanent employment assured to rapid and accurate draughtsman. Bethlehem Steel Company, South Bethlehem, Pa.

**Inquiry No. 1776.**—For dealers in spring steel 3 x 7 and 1-16 thick.

Partner with capital to manufacture latest improved motor cycle. Explosive motor with minimum vibration and weight. No muffler required and no noise, giving increased economy. E. S. Strickland, South Bound Brook, N. J.

**Inquiry No. 1777.**—For revolving magnets for separating iron from other metals.

The Excelsior Machinery Co., of 25 Whitecross Street, London, England, proprietors of inventions in special machinery, are prepared to develop, exploit and negotiate the sale of patented inventions, protected in Great Britain and Europe, also open to undertake the exhibit and sale of any class of machinery; having spacious warehouse and showroom accommodation with power, etc.

**Inquiry No. 1778.**—For revolving barrels for washing metal with water.

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**Inquiry No. 1779.**—For machines for knitting hosiery and underwear.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

**Inquiry No. 1780.**—For manufacturers of motor buses for carrying 12 passengers.

Parties to manufacture and place on the market a Grain Drill specially adapted to the great wheat belt of the North and West; has been tried for two seasons in the sticky soil of the valley of the Red River of the North, and pronounced by the farmers of that country to be the best Grain Drill they have ever seen. Patents have just been issued for United States and Canada. New model just completed has never been offered for manufacture.

THOMAS CARNEY,
411 Brown St., Dayton, Ohio.

**Inquiry No. 1781.**—For manufacturers of steel balls.

**Inquiry No. 1782.**—For wholesale dealers in large quantities of ⅛ or ¾ inch lead tubing.

## INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

December 10, 1901,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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| Acid, apparatus for making sulphuric, T. Meyer | 688,538 |
| Air compressor, E. Hill | 688,520 |
| Air compressor, G. Donges | 688,608 |
| Air or liquid forcing device, A. T. Welch | 688,453 |
| Air register, C. H. Boeck | 688,288 |
| Air ship, R. H. Botts | 688,584 |
| Alarms, etc., apparatus for operating, F. Grinnell ..... 688,304 | 688,306 |
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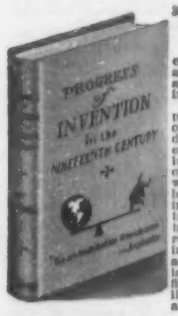

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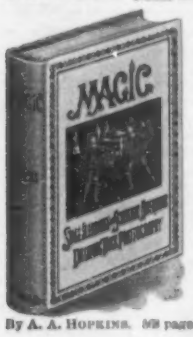

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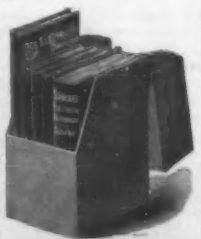

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THE TECHNOLOGY OF PETROLEUM. The Oil Fields of the World. By Henry Neuberger and Henri Noalhat. Translated by J. Geddes McIntosh. London: Scott, Greenwood & Co. 1901. 8vo. Pp. 634. Price $10.

This portly volume with its many illustrations and plates is a remarkable addition to technical literature, dealing as it does with the oil fields of the world, their history, geography, geology, annual production, and development, oil-well drilling, explosives and the use of the torpedo, transport of petroleum by sea and by land, storage of petroleum, various problems, etc. The illustrated plates are numerous and excellent, and give a good idea of the interesting features of the industry. It is an eminently practical book for all who are in any way interested in oil. It is the most comprehensive treatise on the subject which we have seen, and it is very gratifying to know such an excellent addition to the literature of petroleum is now made available to English-speaking readers.

LESSONS IN PRACTICAL ELECTRICITY. Principles, Experiments, and Arithmetical Problems. An Elementary Textbook. By C. Walton Swoope. New York: D. Van Nostrand Company. 1901. 12mo. Pp. 462. Price $2.

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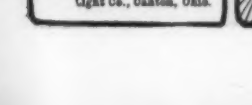

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**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
**References** to former articles or answers should give date of paper and page or number of question.
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(8475) E. A. L. asks: 1. Why is it that while reading about electric currents only the voltage is spoken of so many times? I thought that the amperes was the part of the current which really hurt a man if the voltage was enough to force it through, but I haven't seen any account yet of the amperes used in electrocution, while every paper tells of the great number of volts. A. The number of amperes which a given E. M. F. will cause to flow varies with the resistance. It is certain that enough current will flow with the voltage used to end the life of the criminal. That is as far as practical interest in the matter goes. Most newspaper reporters know only the volt, so they cannot write about the ampere. 2. Is the attraction of two bodies, of unequal weight, the same for each other? That is, is not the attraction of a 5-pound weight for a 15-pound weight of the same material equal to the attraction of the 15-pound weight for the 5-pound? A. No; of course not. 15 pounds will attract three times as much as 5 pounds. See any textbook of physics under gravitation. 3. Is the acceleration of a pendulum, in the quadrant, uniformly accelerated motion? That is, from *a* to *b* and back is the acceleration uniform each way? Will you explain why? A. Yes. Gravity produces the motion of a pendulum. A pendulum is a falling body, and all falling bodies have a uniformly accelerated velocity, because gravity is a constant force. 4. Can you refer me to some reliable works on hypnotism? If possible give me the names of reasonably cheap books and where I can obtain them. A. We can furnish Moll's "Hypnotism" by mail for $1.50. 5. Is there some substance I can use for a filling or sizing on cotton (or other cloth) which would make it tight enough for a gas bag under low pressure? A. Varnish is the most suitable. 6. What can I mix together to make a retort of? Something which will not melt. Is there any way of making plumbago stay in shape? A. Retorts are made of glass. Crucibles are made of fire clay or plumbago. They can be purchased from dealers in chemical materials.

(8476) R. D. asks: If a certain number of cells are used to operate a coil of size described in SUPPLEMENT 160, what the cutput will be, if I know the voltage of each cell that is used, and the number of amperes, if any? A. An induction coil raises the voltage of a current in the ratio of the number of turns in the primary and secondary windings. The length of spark is, however, a better guide to a judgment of the number of volts in the secondary discharge. To throw a spark one inch through dry air requires from 27,000 to 30,000 volts, depending upon the form and size of the terminals.

(8477) E. D. asks: I have a pound and a half of No. 30 B. & S. copper wire, and I wish to make an induction coil, using this for the secondary coil. Will you please tell me what size and how much wire I should use in the primary if I wish to get the largest possible spark? A. No. 30 wire is not adapted for the secondary of an induction coil. It is too coarse. No. 36 is the coarsest which is used for this purpose. Also tell me about how large a spark the coil ought to give if wound properly. A. Perhaps an eighth of an inch. Wind the primary with two layers of No. 12 wire.

(8478) W. H. G. asks: 1. A good battery solution for the gallon size of Ætna Bunsen battery. Please give one that will give heavy current and will not require the withdrawal of the zinc. A. A Bunsen battery uses either nitric acid or bichromate of potash solution on the carbon and dilute sulphuric acid on the zinc. The zincs are not lifted out of the solution, since the Bunsen is a closed-circuit battery. 2. Please tell how I can find the number of ohms a magnet is wound for without an ohmmeter. A. From the size and length of wire on a magnet you can find by means of a wire table the approximate resistance of the coils.

(8479) In the answer to Query 8466 a typographical error occurs. The resistance of No. 36 wire is one ohm for each 2.414 ft. The number given in our reply is one thousand times too large. A period should appear in place of the comma.

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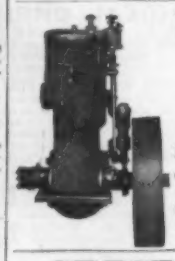

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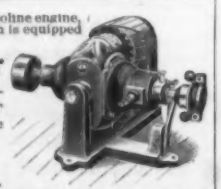

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